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10th Annual Conference of the Subject Centre for
Information and Computer Sciences

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WELCOME

It is again my pleasure to welcome all to this our 10th Annual Conference and on behalf of the Organising Committee, both in the Subject Centre and at the University of Kent, I thank all who have contributed to the event. Each year we are dependent on key staff within the host institution to coordinate arrangements and, once again, we have had tremendous support at the University of Kent. As usual we have also been dependent on many colleagues who have refereed papers and contributed in other ways. The programme itself is indicative of sustained activity from our two communities with offers of workshop provision, poster and formal presentations.

Our programme content this year adds to topical discussion on issues initiated at earlier events, but it is pleasing to note new topics emerging. In addition to the challenge of ever changing technology and the need to keep abreast of this, ethics and professional practice need to be continually reinforced. It is in the latter that it is particularly pleasing to see the emerging 'green' challenge being addressed and the need for all our students in both Computing and Information Sciences to embrace the social responsibility of sustainability in all aspects of their working life. Indeed, from the point of view of the sustainability of the Subject Centre itself, we cannot ignore this challenge. However I believe technology has a good story to tell in what it has already achieved through use in everyday life.

The programme format again facilitates workshops on topical issues, formal presentations and poster sessions, with 2 minute fast sell introductions – a challenge itself in the short time allocated.

Our three keynote speakers bring a useful mixture of computing, information management and technology support for teaching to the conference. Indeed, the speakers bring experiences from academia, industry and support services giving a breadth of knowledge which should be of interest to all participants.

I trust you will find the event of use and take some of the experiences learned back to your own institution for practical benefit in your everyday engagement with students in Higher Education. I look forward to meeting friends from the past and hopefully to make new acquaintances.

Gerry McAllister
Director – Higher Education Academy ICS Subject Centre
University of Ulster

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THE PLACEMENT PITCH PROJECT

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ABSTRACT

ICS students seeking employment need to consider the balance of transferable and subject-specific technical skills required for employability. However, reflection upon individual skills gaps is often an uncomfortable experience for ICS students. The Placement Pitch project is being developed in one university to encourage students to diagnose their personal skills gaps and to take action to improve their chances of employability, particularly within the creative industries. The workshop will present a web-based social networking system being designed to support students in this effort, and shall consider issues for staff setting up such a system and students participating in this type of personal development planning.

Keywords

PDP, Employer Engagement, Collaborative Social Networking

1. AIMS

The workshop is intended to let participants:-

- experience a prototype social networking system based upon the Joomla content management system [1];
- consider common concerns encountered by ICS students performing personal development planning;
- share understanding of issues relating to models of personal development planning as they relate to employer engagement and employability.

2. WORKSHOP FORMAT

The workshop will have four parts:

- a. an introduction to confirm the context for the workshop: personal development planning for ICS students;
- b. a short demonstration of the prototype system, highlighting (i) examples of video submissions from students and (ii) podcasts from potential employers and outlining the tools and resources used;
- c. an interactive development session in which participants are asked to emulate how the students use the system:- create a video (using a pocket video camera), submit it to the prototype system and then share their ideas with or seek help from others in the group;
- d. a discussion of the managerial issues to consider when applying the system.

3. REFERENCES

[1] Joomla <http://www.joomla.org/>

4. ACKNOWLEDGEMENTS

This work is funded by the Higher Education Academy Information and Computer Sciences Subject Centre through their Development Fund. Thanks are also due to the contributors (students and employers) to the prototype system.

EMBEDDING ETHICS IN COMPUTING

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ABSTRACT

Ethical issues abound in Computing. Few would argue that they are not important, and their importance will only increase as computing permeates more and more aspects of everyday life.

Professionals working in computing should always be aware of the ethical aspects of what they do. Students, who will become these professionals, should accordingly be introduced into a culture of considering ethics from the earliest stage of their education.

This workshop and accompanying poster will share the methods and outcomes of a joint initiative to embed ethical issues into various parts of a computing curriculum.

Keywords

Ethics, professional issues, professional development.

1. INTRODUCTION

Ethical issues are important, but it is sometimes difficult to convince students of this. Too often students are carried away with the exciting technology and forget to consider the more social aspects of what they are doing.

One approach to introducing ethical issues is to embed them within modules covering “hard” technical topics. This approach places the ethics firmly in context and can be used to challenge the students to think about the social issues surrounding the rest of their studies.

2. INITIATIVE

The IDEA (Inter-Disciplinary Ethics Applied) CETL [1] is a Centre for Excellence in Teaching and Learning at the University of Leeds. The Centre has been working with the School of Computing to embed ethical issues in the curriculum in a number of ways. These include:

- Ethical issues in teamworking: dealing with defaulters, allocating tasks.
- Ethical issues in AI: can machines be alive, and if so is it ethical to switch them off?
- Ethical issues in the use of Open Source software: is it ethical to use the freely given work of others for profit?

3. WORKSHOP AND POSTER

In the Workshop session we will briefly present those attending with the rationale for embedding ethical issues within the curriculum. Then we will work through one or more of the sessions that have been developed, engaging those present in similar discussions to those we have had with students.

The accompanying poster will again present the rationale and will also pose the ethical questions from the various sessions.

4. REFERENCE

[1] IDEA CETL, <http://www.idea.leeds.ac.uk/>.

OPEN PORTFOLIOS – TEACHING FOR LEARNING WITH WEB 2.0

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ABSTRACT

The increased diversity of entry requirements into HE presents new challenges for academic staff. Both learners and employers question the relevance of extended written dissertations and are now seeking evidence of individual achievement. This workshop introduces the use of common and freely available tools for educational purposes, together with a range of resources to facilitate the use of ePortfolios as a means of evidencing and learning process. Participants will rapidly assemble an ePortfolio and experience how this can be integrated into teaching practice.

Keywords

portfolio, ePortfolio, Web 2.0, learner autonomy

1. INTRODUCTION

Widening participation initiatives are creating demands upon HE institutions to evidence the 'transformative' aspect of a university experience. Learners not only need to develop autonomous 'life-long' skills, but they must demonstrate how they have achieved such skills, in a way that is more relevant to potential employers. Portfolios are a means by which a learner's experiences can be recorded to produce evidence that represents their learning. Whilst the final artefact provides a snap-shot of the 'current' state, the process of assembling a portfolio has much to offer the developing learner. The engagement with portfolio building is primarily affected by:

- The learners' perception of relevance to their learning needs;
- The speed with which a portfolio can be assembled;
- The richness of content within the portfolio that supports a variety of opportunities to reflect upon learning.

2. WORKSHOP AIMS

The aims of this workshop are to:

- Introduce participants to a number of Web 2.0 tools that facilitate the building of ePortfolios;
- Share current practice in the use and organisation of digital artefacts to evidence learning;
- Share current practice in the use of professional development frameworks to provide a learner-centred needs analysis;
- Demonstrate a workflow of activities for rapid ePortfolio assembly;
- Share current practice in the use of ePortfolios for learning as an extra-curricular activity.

3. RESOURCES

Participants will require access to a PC with an internet connection, either in a computer lab or using wireless enabled mobile devices.

4. ACKNOWLEDGEMENTS

This work has been part funded by the Centre for Learner Autonomy CETL at Sheffield Hallam University, <http://extra.shu.ac.uk/cetl/cplahome.html> (2009).

DEVELOPING STUDENTS AS RESEARCHERS: COLLABORATION IN CURRICULUM DESIGN

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ABSTRACT

Exposure to research is something which distinguishes university education from other computing training [1]. Within the themes of the Research and Teaching Nexus and Information Literacy, this workshop will consider how student research skills can be nurtured within the computing curriculum.

Students arrive at university confident in finding information using search engines such as Google. Participants will consider whether this confidence is sufficient to enable students to find the resources they need for academic study. Does the curriculum challenge students to develop their skills further? The QAA benchmarking statement for Computing [2] demands the development of effective information-retrieval skills. The workshop will consider the context in which these skills might be developed within the curriculum and whether there is a more significant need for critical and analytical skills to distinguish between robust and less reliable sources or synthesise information to produce work without plagiarising.

Librarians have become increasingly involved in partnering with academic staff in curriculum design for skills development over the past few years and a large body of literature on good practice in teaching information literacy is now available. The workshop will be facilitated by librarians from Cardiff University and Birmingham City University and a case study of a successful partnership in the School of Computer Sciences in Cardiff will be briefly presented. Participants will have opportunity to share good practice from their own institution and learn from colleagues elsewhere. Participants will consider assessment techniques to reinforce information literacy and a range of practical teaching resources from Cardiff University and Birmingham City University will be shared for re-use.

The workshop designed primarily for computing studies lecturers but LIS teachers and librarians are also welcome.

REFERENCES

- [1] Gordon, N. and Brayshaw, M., Inquiry based learning in computer science teaching in higher education, *Italics* 7(1), 22-33 (2008), <http://www.ics.heacademy.ac.uk/italics/vol7iss1/pdf/Paper2.pdf>
- [2] Quality Assurance Agency for Higher Education, *Computing* (2007), <http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/computing07.pdf>

* Project website: <http://www.cf.ac.uk/insrv/educationandtraining/infolit>

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TEACHING COMPUTING IN A VIRTUAL WORLD: PRINCIPLES AND PRACTICE

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ABSTRACT

In this poster and workshop we describe work underway using the virtual world Second Life to support teaching of the Open University level 1 computing course T175: Living in a Networked World. The poster will describe work to date, with screenshots and key findings so far. The workshop will provide participants with a snapshot experience as a student on T175 – attending an induction session and then visiting one of the inworld resources built to support the course, with time at the end for discussion to capture reflections and answer questions.

Keywords

Second Life, virtual worlds, blended learning, distance support

1. INTRODUCTION

T175, Networked Living: Exploring Information and Communication Technologies is a 30 credit Open University course at level 1 that is presented twice a year. The course description can be found at <http://www3.open.ac.uk/courses/bin/p12.dll?C01t175>. This is a compulsory course in our Certificate in Information Technology and Computing, BSc (Hons) Information and Communication Technologies, BSc (Hons) Computing with Business and BSc (Hons) Computing and Systems Practice among others.

The course is divided into four blocks and is supported through online forum activities on a tutorial and national scale, and through a small number of face-to-face local tutorials, which are historically poorly attended. In the last 2 years three tutor groups have been supported by replacing the face-to-face tutorials with meetings in the virtual world Second Life, with excellent results for retention, and 'taster' Second Life tutorials have been offered coursewide. Last year a two-day course festival was held in Second Life.

The 2009 development of this project builds on our experience and understanding of how we can use Second Life to support student's engagement and learning. We are creating a series of working models to illustrate 2 core concepts from each of three blocks of the course, e.g. the first model is a working RFID subway system. These models are/will be available for the students to explore at their leisure for a limited period of 2 weeks, and are/will be followed up with an open discussion within Second Life.

It is anticipated that the Second Life activity will provide richness by developing the course material into working models, engaging students to support their learning and understanding of key concepts and consequently aiding student retention. The course models can be re-versioned and re-used indefinitely for future presentations of the course.

The poster for this session will describe the project and show screenshots and reflections on work completed to date.

The workshop for this session will enable participants to experience an induction activity, as provided for T175 students, and to explore an inworld resource. Participants will need to have registered with Second Life and set up an account in advance of the workshop, and the workshop will require a sufficient number of computers with the Second Life client installed and tested against firewalls etc. There will be two facilitators to provide guidance and support, and one facilitator present in Second Life. At the end of the session there will be a discussion to capture reflections on experience. The facilitators manage The Open University presence in virtual worlds, and will be happy to answer general questions about working in this environment.

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INTERACTIVE, GRAPHICAL PROGRAMMING WITH ALICE 3

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ABSTRACT

For a number of years, the Robert Gordon University School of Computing has used the Alice virtual 3D environment to teach introductory programming skills to first year computing students. While encouraging engagement with the subject, transition to more conventional languages has often been problematic. In this workshop, we look at the latest version of the software which claims to allow greater integration with the Netbeans Java IDE through textual manipulation of code.

Keywords

Programming, Alice 3, Java, Transition, Graphics, Storytelling.

1. RATIONALE

The use of Alice in both its 2.0 and 2.2 versions has been found by RGU students to be very beneficial to the introductory stages of learning the principles of programming. Accessibility of the drag-and-drop interface, together with immediate visual feedback on the effects of programming statements has meant that students can create programs with relatively complex structures by developing an experimental outlook that concentrates on the narrative aspects of animations rather than becoming preoccupied with correct syntax or algorithmic formality. When coupled with the facility to set open-ended, group-based assessments, we have found that this style of teaching encourages student engagement with the subject and promotes peer-mentoring. One problem which nevertheless remains a significant challenge is the transition to a more conventional programming language such as Java at the end of this introductory period. While some efforts have been made to use additional tools such as BlueJ, the change has often proved problematic, especially for weaker students.

Alice 3 is the latest incarnation of the software from Carnegie Mellon University, and has, among other things more powerful animation functionality using the characters from “The Sims” computer game. It also claims to attempt to address the integration problem by allowing Alice 3 projects to be one-way exported to the Netbeans IDE, with all classes, procedures, functions and properties created in Alice available as Java code that can be further manipulated in such an IDE.

RGU has been trialling this system as a means of overcoming the transition problem and this workshop will provide participants with a practical experience of using Alice for teaching, with emphasis on the integration with Java.

2. WORKSHOP FORMAT

The workshop format will be as follows:

- 10 minutes introduction and demonstration of teaching material
- 40 minutes participation by delegates
- 10 minutes discussion and feedback.

To run this workshop the following will be necessary

- Use of computer lab by delegates
- Availability of Alice 2.2 and Alice 3.0 software (this software is free to use and can be downloaded from www.alice.org).

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NATIONAL PROJECT COORDINATORS NETWORK – WORKSHOP

"DISSERTATION WRITING: STYLE OVER SUBSTANCE"

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ABSTRACT

This workshop is planned as the third National Project Coordinators Network meeting. The workshop is a panel session on the theme "Dissertation Writing: Style Over Substance" with the aim to identify common problems and defining better practice to support the writing up of student projects. The workshop will also consider establishing itself as a self-sustaining network of university computing project coordinators. Further objectives is to discuss issues currently dominating projects and in the foreseeable near future.

Keywords

Projects, Coordinators, Network, National.

1. INTRODUCTION

The goal of the National Project Coordinators Network (NPCN) is the furthering of project practise and to establish a self-sustaining network of university computing project coordinators. The first NPCN (2007) meeting focused specifically on Project Work Pragmatics with the title "*Why do Projects?*" and provided an overview of operational aspects. The second workshop focused on "*Supervisory (mis)behaviour with projects*" and discussed how problems are handled and solved. This panel session will focus on Dissertation writing for Computer Science and related issues to teaching and supporting the write-up of student projects.

2. WORKSHOP OUTLINE AND LEARNING OUTCOMES

- To clarify the necessity for reports and dissertations (if there is one)
- To classify the various types of dissertation that might exist
- To better understand problems and issues faced by students in their writing of dissertations
- To identify different methods used by institutes to improve dissertation writing
- (Issues currently dominating projects and in the near future)
- (Network sustainability and future meetings)

3. PANELLISTS

Moderator: Professor Roger Boyle, Head of School of Computing, University of Leeds

Panelists: To be arranged nearer the workshop date.

4. REQUIRED PREREQUISITES

Participants are requested to complete an on-line questionnaire prior to the meeting – these will form the basis for discussion.

Questionnaire: <http://www.comp.leeds.ac.uk/projectnetwork/npcn09-questionnaire.html>

5. ALiC CETL

The ALiC (Active Learning in Computing) CETL (Centre of Excellence in Teaching and Learning) focuses on increasing the level of student engagement within the computing curriculum. ALiC is led from Durham University with the University of Leeds, University of Newcastle and Leeds Metropolitan University.

ALiC aims to increase levels of student engagement in the curriculum, better equip students for employability, better integrate research and teaching activities, and revolutionise the learning environment.

STRATEGIES FOR STUDENT LEARNING THROUGH RESEARCH

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ABSTRACT

It is an attractive proposition for UK Higher Education institutions to advertise their learning experience as being 'research-led' or 'informed by research'. This workshop examines some simple strategies for creating more positive, visible links between research and teaching activities, and illustrates how a strategy for incorporating these activities into the curriculum can be built by way of a strategic assessment tool.

Keywords

Curriculum development, Research-Teaching Nexus

1. INTRODUCTION

It is recognised that learners should develop and practice key skills during their Higher Education experience, but more importantly they should understand not only the process of knowledge creation, but how that knowledge is applied to disparate domains. Research is often seen as an activity that supports our desire to facilitate learner growth, and many institutions have integrated discipline research into their curricula. Elton [1] argues that learning and teaching environments that support the processes within learning, teaching and research create more positive links between research and teaching for learners and academic staff. Healey [2] suggests that undergraduates are likely to gain most benefit from research in terms of depth of learning and understanding when they are involved through enquiry-based learning. The use of research to inform the curriculum makes explicit the systematic enquiry into the teaching and learning process itself, which is achieved by embedding four key principles into the learning experience of the institution. Using the work of Tosey [4] and Seel [3] to lead institutional change at Sheffield Hallam University, an approach using these key principles is described that facilitates the development and delivery of Research Informed Learning and Teaching policy and practice within a higher education computing department.

2. WORKSHOP AIMS

The aims of this workshop are to:

- Introduce participants to activities that support the Research-Teaching Nexus in the Computing discipline;
- Introduce participants to a strategic assessment tool for use within the Institution/Faculty/School/Department;
- Enable participants to produce an action plan for including research based learning and teaching activities in their own curricula.

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ETHICAL REVIEWS OF INFORMATION AND COMMUNICATIONS TECHNOLOGY RESEARCH PROJECTS ACROSS UK COMPUTING DEPARTMENTS: THE STATE OF THE ART

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ABSTRACT

This paper identifies both a conceptual and policy vacuum with regards to ethics reviews before, during and after research in Information and communications Technology (ICT). It describes the findings of an HEA development project that undertook to determine the state of the art of ethics reviews in UK higher education institutions. The paper presents a survey that indicates the current ethics review procedures that currently exist across UK computing departments. The findings underline the relevance of ethics reviews when conducting ICT research.

Keywords

ICT, research, ethics reviews, procedures, principles

1. INTRODUCTION

Research in Information and communications Technology (ICT) is broad and varied owing to the increasing convergence of technologies. It involves human beings and gives rise to varying levels of ethical problems. ICT research therefore requires an adequate regulatory model. Presently, there seems to be both a conceptual and policy vacuum before, during and after research in ICT. There is a need for decisions to be taken, ethical problems solved, legislation needs to be adopted and ethical framework for research review formulated and implemented. (Floridi, 2006) This is necessary because ethical frameworks for research on human subjects such as in biotechnology may not be appropriate. A framework specific to ICT research and its application is important. There are political and ethical pressures to be proactive in the consideration of ethics in ICT research projects rather than be reactive later on. These concerns are of importance to higher education institutions because an exposure to research is considered one of the hallmarks of higher education and future researchers need to understand the relevance of ethics reviews during their taught studies.

Developing a standard ethics review procedure based on shared good practices is desirable. It will contribute to a more proactive research community where students, staff and institutions working on ICT will conduct research that meets key ethical principles. It will encourage good and ethical research and ultimately ensure the sustainability of ICT research. The aim of this research is to identify the current state of the art in ethical reviews of ICT projects in UK computing departments and understand the ethical issues involved in ICT research so as to develop such ethical framework that will provide a frame of reference for UK researchers in ICT. The main research question discussed in this paper is;

- What ethics review procedures currently exist in ICT research in the UK?

This question is meant to provide the empirical grounding for further research into questions like:

- What is ICT and what relationship exist between ICT and ethics?
- What is ethics review and why is it necessary in ICT research?

The overall aim of the project is to develop theoretically sound and empirically valid recommendations for ethics review in ICT research.

In this paper, based on the empirical findings of a UK-wide survey, the importance of ethics reviews in ICT research is underlined. An analysis of a survey on the current ethics procedures in UK computing departments is presented followed by its limitations and suggestions on future research.

2. IMPORTANCE OF ETHICS REVIEWS IN ICT RESEARCH

Many scholars including Moor (1985), Tavani (2006), Bynum, (2006) and Stahl (2004) have noted the importance of ethics in ICT. In different ways, these scholars have explored the role of ethics in the use of ICT artefacts. Not many have talked about ethics during research in ICT, thus leaving a conceptual vacuum in their strong arguments for ethics. Part of incorporating ethics into this area should however, start with the research into ICT. It is crucial therefore, that researchers in ICT carry out their research ethically. An ethical review of the work of ICT researchers is one possible way of achieving this position.

Here, ICT is defined as the production and usage of artefacts that can store, retrieve, manipulate, transmit and receive information electronically in a digital form. It includes personal computers, network hardware and software, satellite systems digital television, radio, robots. It is differentiated from Information Technology (IT) which concentrates more on the production of the artefacts alone and also Information System (IS) that finds meaning in organizations which usually refers to businesses. It represents a technological convergence that emphasises equally the production and the usage of the artefacts.

The emergence of increasingly unpredictable, uncertain and unquantifiable benefits and risks associated with ICT research indicates the need to establish a procedure that will critically reflect on the ethical, social and sometimes environmental implications of both the development and usage of ICT. A procedure that will embed ethical considerations in ICT by discussing the needs and goals of the society and then serving as a framework to guide research towards these goals. That procedure is called ethics reviews.

Ethics review is an integral part of research ethics that promotes the adherence to ethical norms in research so as to maintain the aims of research such as knowledge, truth, avoidance of error and harm. Ethics reviews are processes set up by research institutions to find out if ethical norms are being adhered to during research. This process understands the ethical norms involved in the research, discovers both actual and potential ethical problems associated with the research and makes certain these norms are adhered to and the problems get effective solutions. Owing to the dynamic nature of ethical problems, ethics review should be based on a process that operates both before, during and after the research- whether it is in medicine, social science, psychology or ICT. This helps in developing a guideline that makes research effective.

The principles of the World Medical Association (WMA) declaration of Helsinki of 1964 (WMA, 2004) are always highlighted as established principles on which research ethics arguments are based on. Such disciplines as biotechnology, pharmaceuticals, psychology and social sciences have adopted these principles and extensively use them in their ethics reviews. This declaration proposed certain fundamental ethical principles for research that involve human subjects which include;

- **The principles of beneficence and of non-maleficance-** that the researcher ought to do good and avoid both physical and psychological harm to the research subjects.
- **The principle of autonomy-** that every individual has the capacity for self-determination. This implies that such an individual should be free from coercion in decision making and others should respect his/her decision, protect his privacy and maintain his confidentiality. In research therefore, informed consent points to an individual's autonomy.
- **The principle of equality and justice-** that every human individual has rights to be treated equally as others are and also the right to a just and fair treatment. Discriminations in research should be avoided.
- **The principle of integrity and best action-** that the best actions should be employed in research so that the well-being of the human person will be taken into account.

Ethics reviews ensure that these principles are realised in research. The above principles provide support for arguments on ethical issues related to ICT such as privacy, intellectual property rights, trans-humanism, autonomy, cybercrime and other issues relating to research in general like voluntary participation and informed consent. These issues and other ethical issues related to ICT research have continued to get little attention from computer scientists before, during and after research is conducted owing to lack of ethics review procedures.

3. A SURVEY ON THE CURRENT ETHICS REVIEW PROCEDURES IN UK COMPUTING DEPARTMENTS

The Centre for Computing and Social Responsibility (CCSR) De Montfort University, Leicester, supported by the Higher Education Academy of UK has carried out a survey to investigate the current state of the art in

ethics reviews of Information and Communications Technology research across the UK. An analysis of this survey is presented in this paper.

This survey was designed to help understand the current state of the art in the ethical reviews of ICT research projects in the UK, identify the ethical problems research in ICT raise in the UK, identify the challenges ethical reviews of ICT research face in the UK, and ultimately provide information on how to build a practical and effective framework for ethics reviews of ICT research. The research technique used for this survey was questionnaire. It was an empirical research that made use of the qualitative data collection strategy of survey-questionnaire. The data collected was however of both quantitative and qualitative in nature, thus requiring the use of qualitative as well as quantitative data analysis.

The findings of this survey point to the fact that there is a need to establish an acceptable ethics review framework in ICT research. While some respondents do not see the need for ethics reviews in ICT research, there is a considerable agreement among the respondents that ethics reviews are relevant in the development of good research practices in ICT. Issue by issue these findings will be analysed followed by the limitations of this survey and suggestions for further research.

The questions were developed on the basis of an extensive literature survey on research ethics and computer ethics. The aim was to ask questions that would allow respondents to give clear answers that would allow the researchers to understand current procedures and resulting issues. The questionnaire was pre-tested on several PhD students and members of staff of the participating institution to ensure consistency and understandability. The main survey questions are summarised in Appendix A. Below is a summary of the most important findings.

3.1 Relevance of ethical reviews in ICT research

96.7% of the respondents agreed that ethics reviews are relevant in ICT research projects while only 3.3% disagreed. The arguments of the 96.7% who believe in the relevance of ethics reviews in ICT research include the facts that; it is the university policy, it maintains professional standards and finally that many of these projects involve human subjects and therefore raises sensitive ethical problems.

3.2 Availability of Ethics review boards or other means of reviewing the ethical content of research in ICT in UK universities

83.3% of the respondents indicated the existence of ethics review boards or other ways of reviewing the ethical content of research projects in their computing faculties/departments. About 6.7% indicated that no such board exists in their institution while 13.3% do not know if such boards exist. 23.3% of these respondents are members of such boards in their institutions while 76.7% are not. Descriptions of the ethics review procedures offered by this 23.3% show that it generally involves filling of forms and gaining approval from the board. One of the responses indicated that this procedure is still based on the ethical principles for conducting research with human subjects promoted by the British Psychology Society. Notably, these responses do not indicate any follow up procedure during and after the research but on a positive side offers credence to the fact that ethics reviews are understood as relevant in ICT research projects.

3.3 Clarity of ethical review policies to affected Individuals (staff, researchers and students)

Even though the majority of respondents indicated the existence of ethics review boards and policies in their institutions, the most important question is, are these policies clear to all affected individuals including staff, researchers and students? From the responses, only 56.7% thinks that it is clear while 33.3% thinks the opposite. Is this because the procedure only reviews selected projects? To answer this, 36.7% indicated that their procedure reviews all projects, 40.0% said their reviews not all but specific projects while 20.0% answered 'do not know'. Another issue identified here that can make the procedure unclear is whether it distinguishes between different levels of research; undergraduate, graduate and research carried out by staff. 56.7% answered yes that it does distinguish, 23.3% said no, it doesn't while 16.7% answered do not know. All these indicate that there is a problem of clarity encountered by some affected ICT researchers with regards to ethics review procedures.

3.4 Problems and challenges raised by ethical review policies in UK Universities

Asked if the ethical review procedure of their institution face any problems or challenges, the respondents raised various issues that warrant serious attention. While some maintain that their procedures are generally accepted and well balanced, many point out that the forms involved make ethics seem like a box-ticking exercise. The latter group believe that many researchers consider it an additional and insignificant hurdle to

pass and therefore they tend to see it as an obstacle to research. Mostly the respondents indicated lack of awareness of ethical issues as the reason for this perception. Other challenges to this procedure raised by the respondents include lack of a technique to follow up the outcome of the research, time constraint and audit issues, volume of work, the sheer number of the projects, especially of undergraduate projects and lack of seriousness exhibited towards the procedure by researchers.

3.5 What can be changed about ethics review policies in UK Universities

Respondents were asked to describe how they can change the existing ethics review policies in their institutions if given the chance. Responses to this question point to the fact that while a little percentage of the respondents is happy with the existing set-up, many feel dissatisfied. For those who are dissatisfied, the major change should be the simplification of the procedure either by cutting down the number of forms to be completed or by substituting the forms with a statement regarding the ethical implications.

Other interesting suggestions offered by the respondents include the ethical review of **all** ICT research projects and not some specific projects, the introduction of ethics training for Head of departments, improvement of publicity in ethics review issues, introduction of an ethics review process that is interactive and not just a box-ticking exercise- that should be ongoing with the research and through to the outcome of the research and finally raising awareness among project co-ordinators, supervisors and students.

3.6 Should every UK computing department establish an ethics review procedure?

This question was designed to discover the acceptability of ethics review procedures in computing departments in Universities. Figures show that 86.7% of the respondents answered yes to this while 13.3% do not want to see computing departments establish an ethics review procedure. Findings suggest that many of those who make this recommendation do so because they consider it as part of the best practice in ICT and academic work in general

Of the vast majority of the respondents who said yes, the general belief is that research in ICT have an impact on the society and increasingly involve human subjects, therefore, ethics review procedures in universities are necessary both for ethical reasons and for legal reasons. They believe that computer scientists are generally concerned with the technical efficiency of their projects, that they sometimes forget the human implications. These procedures would help to raise that awareness and hopefully lead to better practice. It would also give both staff and students a good appreciation of the responsibilities of researchers to the society. Given these responses, one can conclude that majority of computer scientists would like to see an effective ethical review procedures established in their departments which is not the case at the moment.

4. CONCLUSION

4.1 Limitations of this Survey

345 respondents from different academic backgrounds in 97 UK computing departments were contacted for this survey but only 30 participants from 28 universities responded. These figures indicate that all of them, except for one PhD student, are in the group of those who work closely with Ethics review boards or are senior researchers in their departments. Therefore, one can level a self-selection bias argument on the findings of this survey. Those who handle minor research in the department such as undergraduate students, Masters students and Ph.D students were not well represented.

However, the fact that many of these minor researchers such as PhD students contacted for this survey did not care to respond might be an indication that they are little aware of this issue or care less about it.

4.2 Future Research

The findings of this survey suggest the lack of an established effective framework for ethical reviews of ICT projects in UK universities. Nevertheless, there are a number of universities who have adopted ethical guidelines, such as that published by the British Psychology Society, which helps in the review of their projects.

This paper suggests a future research on how to reconcile the differences in the existing ethics review policies in computing departments in UK in order to establish a unified ethical guideline for ICT research in the UK and also on how to develop an effective framework for ethics reviews. Other future research suggestions include how can UK computing departments provide an academic environment that encourages ethical research by promoting integrity and best practices? What are the benefits of regular ethics training for both staff and students- to raise both old and novel ethical issues in computing science?

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6. APPENDIX: QUESTIONNAIRE (WITHOUT DEMOGRAPHIC QUESTIONS, POSSIBLE ANSWERS IN PARENTHESES)

- 1. Do you think ethical reviews are relevant in Information and Communication Technology projects? (YES/No)
- 2. If YES why?
- 3. If NO, why not?
- 4. Does your institution, computing faculty or computing department have an ethics review board or any other way of reviewing the ethical content of research projects? (YES/NO/DO NOT KNOW)
- 5. Are you a member of this board or panel/process? (Yes/No)
- 6. If YES, can you briefly describe your ethics review procedures? (free text)
- 7. If you have your ethics review policy online, please can you give us the link below?
- 8. Do you think that your ethics review policy is clear to all affected individuals (staff, researchers and students)? (Yes/No)
- 9. Do all your faculties'/department research projects go through this board's procedures or do you review specific projects? (All Research Projects/Specific Research Projects/DO NOT KNOW)
- 10. Does this procedure distinguish between the different levels of research; undergraduate, graduate and research carried out by staff? (YES/NO/DO NOT KNOW)
- 11. Which problems or challenges does this procedure and its implementation face in your institution? (free text)
- 12. If given the chance, how would you change this procedure? (free text)
- 13. Would you recommend that all computing departments in the UK establish an ethics review procedure? (Yes/No)
- 14. If YES, why would you make this recommendation? (free text)

SUSTAINABLE DEVELOPMENT AND SOCIAL RESPONSIBILITY - MAKING IT PROFESSIONAL

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ABSTRACT

In this paper we will consider some of the aspects related to the teaching of sustainable development within the Higher Education computing curriculum – including students' views on the relevance of this to their education. The inclusion of sustainable development material within the curriculum can link with the professional development and career planning of students, as well as providing an appropriate vehicle for the teaching of ethics and exploring issues of social responsibility. The growing recognition of this general area by government, professional bodies and industry means that it can be considered as the role of computing departments to develop this awareness and set of skills in students.

Keywords

Sustainable Development; Professional issues; Social Responsibility; ethics.

1. INTRODUCTION

Sustainable Development is now part of the Higher Education and Funding Council for England (HEFCE) strategy [12], as part of the international Education for Sustainable Development agenda which itself comes under the more general Sustainable Development theme. A succinct characterisation of sustainable development is provided by HEFCE [11], itself based on a quote from the World Commission on Environment and Development [16]

“development which meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The subject of sustainable development encompasses a number of topics. The U.K. government has identified four priority areas [6], namely:

- “Sustainable Consumption and Production;
- Climate Change and Energy;
- Natural Resource Protection and Environmental Enhancement;
- Sustainable Communities”.

Computing has links and applications in many of these areas, in particular to consumption, to energy, and to communities. Furthermore, applications of I.T. systems can be found in all of these areas. In the following paper, we will initially consider how this topic relates both to the professional development and potential professional practice for our students and how this relates directly to the issue of social responsibility. We then consider the teaching of some aspects of this topic within a first year, undergraduate I.T. and Professional Skills course. Finally, we report on some of the findings from a survey of students' perspectives on this topic.

2. SUSTAINABLE DEVELOPMENT AND PROFESSIONAL DEVELOPMENT AND PRACTICE

2.1 Professional development and practice

The environmental impact of computing is become of increasing concern. Within the U.K., government bodies are beginning to recognise this and DEFRA has been implementing a green I.T. strategy [11]. Furthermore, industry and professional bodies such as the British Computer Society (BCS) are also recognising this. In terms of industry, employers are beginning to consider the awareness of sustainable development of potential employees [3] as well as the wider issues of the environmental impact of I.T. and the commercial and social drivers that mean there are benefits to industry taking account of these [15]. Regarding professional bodies, the BCS includes professional practice and ethics in its code of conduct and accreditation guidance [1], and as well its endorsement of the EU Code of Conduct for Data Centres [7], has recently introduced a separate

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qualification – the Green I.T. Foundation and is developing a Practitioner Certificate for data centre operators [2]. As well as the environmental cost of I.T., there is also scope for I.T. to provide innovative solutions and reduce the much larger cost of other carbon producers [4].

2.2 Ethics and social responsibility

The teaching of professionalism and ethics, and in particular developing an appreciation of ethical dilemmas and contexts is recognised as an important facet of the computing curriculum, as recognised by the Quality Assurance Agency in their benchmark statement for computing [14]. Furthermore, the impact of I.T. and computing on society, in particular with the Internet and the ubiquitous nature of computing within many people's life is leading to a growing interest in the notion of social responsibility. This recognition means that these topics become an issue for curriculum design [13]. Examples of some of these concerns include the impact of technology on the development of children's learning and social skills; the use of the Internet as a medium for terrorism and the distribution of pornography; the environmental costs of maintaining the infrastructure and growing demand for data. Further examples of the increasing social aspects of computing are the digital divide – both within a nation and between nations; the change in the nature of work and production – for example the move from manufacturing based to service-based knowledge economies for countries such as the U.K.; the increasing level of dataveillance and the potential impact on civil liberties and personal privacy. The interest in this area can be seen from the development of groups such as the "Computer Professionals for Social Responsibility [5].

This area can also be linked in with the legal context in which professionals will function. With the growing interest in carbon footprints, and with explicit legal requirements such as the European Waste Electrical and Electronic Equipment Directive legislation, there is a growing legal framework which will have an impact on graduates' future careers.

3. SUSTAINABLE DEVELOPMENT IN THE COMPUTING CURRICULUM

3.1 I.T. and Sustainable Development

Within the H.E. computing curriculum, there are numerous places where sustainable development can be embedded [9]. Within I.T. teaching for example, good examples of the environmental impact can be found – such as the huge costs of continuous upgrading of hardware. Software itself has a cost – this includes the potential need to upgrade or replace machinery in order to run the latest version of operating systems or applications, as well as the actual running costs of the software (processor intensive programs increase power usage). The financial and social costs to individuals, institutions and nations of these examples provides an opening for teachers to explore numerous topics, and to develop this awareness in learners. These provide good cases to develop discussions on ethics, social impact and the related professional and legal considerations. Such explorations may include considering different approaches – such as developing less resource intensive systems or perhaps open source solutions. Teaching resources - such as photos of piles of obsolete keyboards, or of children in third world countries recovering wiring and chips from pc motherboards which organisations such as Greenpeace provide [10] can bring home to students the wider global impact of the use of computing equipment and the industry's continual demand for upgrades and updates. This material also links in with professional development and awareness – for example, within computing material can be linked with the I.T. industry codes of practice for data centres and other guides which have a growing emphasis on sustainability. Considering the U.K. government's priorities, examples can be found within the computing curriculum which addresses these. For example:

Sustainable Consumption and Production: as noted above, the demands for system upgrades (domestic and commercial) as well as the move to continuous provision of service (e.g. domestic devices that are always powered and available) needs to be balanced with the views of sustainable consumption and production. Server based solutions – such as Google Docs [8]– can be considered as one way of addressing such concerns.

Climate Change and Energy: the power consumption of I.T., from data farms to individual domestic appliances fit in with this topic. Furthermore, the potential for I.T. use in modelling climate change, and in improving other systems (such as the logistics of transport) demonstrate ways in which technology can alleviate some problems.

Natural Resource Protection and Environmental Enhancement: in a similar way to the previous point, I.T. can provide ways to protect natural resources e.g. through routing and optimization of other systems to improve efficiency and reduce the damaging impact of things such as the transport (i.e. road) networks;

Sustainable Communities: examples here include the use and impact of ICT within communities, such as the changes that global communications can have, the influence of global communities and changes in patterns of work (e.g. with off-shoring of service industries, and in particular the outsourcing of software development).

3.2 Example learning activity

Example learning activities include providing students with a simple model of the power usage of a collection of typical devices. For typical students in H.E., this could be a computer, hi-fi, television, cooker, washer, and set top box. Depending on the focus of the course and the level of the students, they can be provided with a sample spreadsheet or software which has the necessary calculations and data built in, or they can be asked to find the data (e.g. the power usage of the devices) and/or the calculations for power usage (i.e. how to calculate the KW hours per device). By calculating the daily usage: based on so many hours switched on, x say, the number of hours on standby, y say, and the number of hours turned off, $z=24-(x+y)$ they can calculate the daily power usage of a device and thereby the annual power usage. Making use of the Internet they can find the cost per KW Hour of electricity in their area, and hence the daily and annual cost of powering the device. With the model in place, they can see the immediate effects of altering the amount of time on standby in terms of power usage and actual monetary benefit. Finally, by finding the carbon footprint per KW Hour they can calculate the environmental cost of that device, and how they can best minimise this. A more advanced version of this can be to ask the students to develop a simple application that utilises web services to gather the data on power costs etc.

4. STUDENTS' VIEWS ON SUSTAINABLE DEVELOPMENT TOPICS

In order to gauge the level of student awareness of, and concern about, sustainable topics and professional issues, we carried out a survey of our first year students prior to the teaching of these topics. The survey was carried out on a module with approximately 140 students, and the data summarised below is from an initial survey designed to determine student opinion prior to any teaching on professional issues or on any of the topics directly related to sustainable development.

The response rate was 27%. The cohort in question was mainly male (80%), and mainly under 29 years of age (65% < 20 years old, 24% between 20 and 29). 55% of the respondents had heard of the term sustainable development.

| Question | | |
|---|---------|--------|
| | Yes (%) | No (%) |
| Are you aware of any requirements to demonstrate an awareness of social and ethical issues within your programme of study? | 32 | 68 |
| Were you aware that as a professional practitioner you will be expected to take account of the social and environmental impact of your work? | 58 | 42 |
| Do you consider it is appropriate to include content about sustainable development within the modules you attend on your specialist subject? | 45 | 55 |
| Given your subject of study, do you believe that your subject has any potential impact to any area of sustainable development – environmental, social or other? | 46 | 54 |

Table 1: students' views on sustainable development

The results summarised in Table 1 demonstrate the level of awareness that new students have on entry to their course. The high proportion of students who claim they are unaware of the need to cover ethical and social issues is somewhat unexpected. For the particular course in question, students are enrolled in the BCS as student members in induction week, and the module that included this material includes "Professional issues" within the title. In spite of this, students did not expect to cover this within their study. However, they did expect to take account of it in their later work – so this may demonstrate a lack of expectation that their course would include this type of material, rather than a lack of awareness that this is relevant to their professional development and future careers. In this context, it still seems surprising that a majority of students did not think it appropriate to include this type of material in their modules and shows a disjunction with the requirements and expectations of accreditation versus the expectations of students. The last question in the table is perhaps the most astonishing – the lack of awareness of the impact of computing and I.T. on the environment. This may relate to assumptions about (individual) computers having low power requirements, and the relatively low cost of modern hardware. However, challenging these assumptions and developing awareness of the commercial and social context is something that appears to be needed for many of our students.

5. CONCLUSIONS

We have considered some aspects of the ways in which sustainable development topics can be an effective context in which to develop awareness of social responsibility in our students. Furthermore, we have seen how these topics relate directly to the professional ethos that we aim to engender in our students. In developing this awareness, we should avoid any attempt to force a particular stance or viewpoint, but there are numerous drivers for the inclusion of these topics include the government, industrial and professional agendas within which we operate. The summary of student views on sustainable development identifies some of the challenges we face as teachers – where student expectations and desires can be in apparent conflict with the agendas just considered. However, these topics do offer some real world examples and case studies with which to link the technology that we teach with the professional, legal and social aspects that are expected to be a key feature of the working professional lives of our students.

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AUTOMATED ESSAY SPINNING – AN INITIAL INVESTIGATION

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ABSTRACT

This paper examines automated essay spinning, where a new variant of an essay can be easily produced by a student for them to submit for academic credit. This new essay represents plagiarism. Four spinning processes are tested to generate new versions of three corpora of documents. The originality of documents in the new corpora are assessed using three plagiarism detection tools, Turnitin, TRanker and Ferret. The technique of Automated Translation, where an essay is translated to and from English, perhaps via a sequence of other languages, is found to produce presentable work which may not be detected as unoriginal.

Keywords

Student cheating, student plagiarism, plagiarism detection, article spinning, essay spinning.

1. INTRODUCTION

The problem to academic integrity posed by student plagiarism should require little introduction. The battle between students to plagiarise successfully and for tutors to detect this plagiarism has been likened to an 'arms race'; that is, students are always finding new and more efficient ways to cheat [4]. These new ways may be difficult for tutors to detect using standard anti-plagiarism software. This study continues the pattern of publicising potential cheating methods in an attempt to ensure that academics have information about them readily available [10].

One method that students may use to cheat successfully is to simply rewrite an essay until it is worded substantially different to the original. Where plagiarism detection software operates by looking for common word sequences between two documents, as is believed to be the case by the market leading detection software Turnitin [18], there must be a level of changes that students can make beyond which their cheating is not likely to be detected. An extreme case would see a student rewriting every sentence in an essay. For the student such thorough rewriting is substantially faster than researching and writing an essay from scratch.

Observation suggests that when students try to plagiarise they are looking to do so whilst exerting as little effort as possible. Hence, in-depth rewriting is unlikely to be time-effective for them. Students may instead be moving towards faster rewriting techniques, such as those used for producing content for the web.

This paper presents an initial study into rewriting using computer-based techniques, focusing on those that can be done with little student intervention. The techniques are largely formed from a combination of online forum discussions with a marketing focus. As the original ownership of such techniques is largely impossible to trace, any sources presented in this paper merely provide more information about the techniques. The results obtained by automated rewriting are tested on three representative corpora of data and examined using current plagiarism detection tools. This will inform the direction that future work on plagiarism should take.

2. ARTICLE SPINNING

Article spinning is a technique through which articles are rewritten (or 'spun') so that the new article appears to search engines to be substantially different to the old one [1]. This gives the potential for the new article to appear high in the web search engine rankings, potentially allowing the owners of the corresponding web site to make money from the new, but not strictly original, article. As the spun articles attempt to fool the search engines, this is known as an example of 'black hat marketing' [3]. Much of the success of search engines like Google [8] depends on the successful de-indexing of spun articles, a technique not dissimilar to that used by

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plagiarism detection engines, such as Turnitin [18] to link copied assignments to original sources.

Different methods of article spinning exist, ranging from automated, to semi-automated, to fully manual. Fully manual spinning might involve reading an article, then rewriting it, perhaps with the aid of voice recognition software. Semi-automated spinning might involve synonym substitution, such as replacing an occurrence of 'big' with 'large'. Automated spinning could carry out this process, but using random synonym substitution. Such substitution could occasionally result in unlikely looking text where incorrect synonyms were selected.

Very little academic work has been carried out on article spinning and its detection. Malcolm and Lane conducted an initial study into the detection of articles spun using synonym substitution [14]. The focus of the study was not on the generation of spun documents, so it is impossible to surmise whether these were automated or semi-automated. Instead Malcolm and Lane collected a small corpus of pages from a web site that consisted of spun versions of content available elsewhere. Their investigation showed that Turnitin and their own tool Ferret [13] found some of the spun text, and that Ferret found more than Turnitin. Neither tool found all spun text. The need for further in-depth study and continued algorithm development was noted.

The remainder of this paper focuses on how article spinning techniques can be used on essays. For clarity, this process will be named 'essay spinning'. In order to focus on students operating with time limitations, the studies will focus on fully automated techniques. The paper will examine a variety of techniques used on three corpora of documents. It will aim to identify how well anti-plagiarism engines can detect spun essays.

3. AUTOMATED ESSAY SPINNING TECHNIQUES

Four automated sets of essay spinning techniques have been selected for testing, based on the criteria that the techniques must be freely and easily accessible to students. This may be in free software, or in standard applications found on PCs. The sets of techniques are briefly introduced as follows:

1. Cut-Up – 'idea generation' techniques, where fragments of texts are rearranged with an attempt to preserve grammatical meaning. Further 'text mixing' may occur through a series of filters. A single filter may, for instance, replacing all male pronouns with female pronouns [5].
2. Markov Text Generation – text is generated with the same properties of relationships between sequences of words as in an original set of documents [16].
3. Automatic Summarisation – this involves taking a document and replacing it with a summary of its contents, designed to have the same meaning [2].
4. Automatic Translation – a document is translated into foreign languages and back to English [15].

Table 1 details how examples of the four techniques will be applied using available software and the resulting text automatically spun from an original, along with WC, its word count. The techniques chosen are largely intended to be illustrative. For instance, other tools could be chosen to apply the same techniques, or different values could be selected for variables. The techniques are deliberately kept simple and a student might be able to substantially improve on the level of originality and disguise in the output with thought and rewording.

| Identifier | Process | Text Spun From Original | WC |
|------------|--|--|----|
| Original | Original, unspun text. | Many people believe that some people enjoy eating broccoli. They might also enjoy eating other vegetables. Perhaps it is the case that some people do not enjoy eating broccoli. It can represent an acquired taste. | 35 |
| Cut | Produced using Open Wound [17], via tagging, then text generation. | Many people believe that some people enjoy eating taste. They might also enjoy eating other people. It can represent an acquired taste. | 22 |
| Mark | Produced using Doctor Nerve [6], with 500 words output selected. | ... Many people believe that some people enjoy eating other vegetables. It can represent an acquired taste. Many people enjoy eating other vegetables. It can represent an acquired taste... (Total size 500 words) | 28 |
| Sum | Summarised to 75% using AutoSummarize from Microsoft Word menu. | Many people believe that some people enjoy eating broccoli. They might also enjoy eating other vegetables. It can represent an acquired taste. | 22 |
| Trans | Translated using Google Translate [9] in the sequence English, Greek, Japanese, English. | I think people enjoy eating broccoli and a lot of people. Also, you can enjoy eating vegetables. It probably is, some people enjoy eating broccoli, it's not true. May be acquired tastes. | 32 |

Table 1 – Automated Essay Spinning Techniques

It is evident from Table 1 that the standard of English language in the spun text can vary substantially. No attempt will be made when comparing the texts generated to assess the quality of the English language. Neither does the Markov Generation attempt to accurately model the expected size of the resulting text to be close to the original. Further, the quality of some techniques, such as Markov Generation and Cut-Up can be substantially improved with larger text samples, which may not be apparent from the short original source text.

4. SIMILARITY ANALYSIS TOOLS AND TECHNIQUES

In order to accurately assess the originality of spun versions of each document three tools have been identified from the literature. Turnitin [18] and Ferret [13] are included based on Malcolm and Lane's study [14]. TRanker (part of PRAISE) [12] is included based on Lancaster and Culwin's work [11]. The tools are based around a varied selection of algorithms that the literature suggests are all potentially useful for detecting plagiarism.

| Tool | Overview of Technique | Similarity Analysis Process |
|----------|--|--|
| TRanker | Calculates commonality between two documents. The word pairs (bigrams) algorithm is suggested. | TRanker is run to compare each spun document with its original. The word pairs metric is selected. A resulting similarity score between 0 and 100 is obtained. |
| Ferret | Calculates based on the number of three word sequences (trigrams) in common between two documents. | Ferret is run to compare each spun document with its original. A resulting similarity score between 0 and 1.0 is obtained and scaled to between 0 and 100. |
| Turnitin | Algorithm not publically released. Believed to look for longer sequences of common words. | Initial corpus of documents manually added to Turnitin. A similarity score from 0 to 100 is obtained from each spun document. |

Table 2 – Similarity Analysis Techniques

Note that the numbers obtained from the tools do not directly represent percentages and so any comparisons on this form are only approximate. In particular, the Turnitin measure may include a small amount of 'noise' based on matches elsewhere in its database, other than just from a single source document. Informal checks have shown that this should not affect the overall accuracy of the results. All scores are processed as integers.

5. CORPORA PRODUCTION

Table 3 shows three plain text corpora from which spun versions will be generated. Two are sets of ten anonymised student submissions, designed to be representative of different types of work. The third corpus consists of ten web articles from Ezine Articles [7], designed to be representative of those spun for web content. Articles in each corpus are selected at random from a larger possible set of all those available.

| Corpus | Description | WC | Flesch | Fog |
|------------------|--|--------|--------|------|
| Ezine Articles | Random articles from the most recently approved list. | 812.2 | 64.9 | 11.8 |
| HCI | First Year individual HND HCI assignment based on the application of Nielsen's Usability Heuristics. | 723.8 | 55.5 | 13.9 |
| Research Methods | Second Year degree computing research task design assignment, completed in Action Learning Sets. | 1681.9 | 51.2 | 13.2 |

Table 3 – Corpora of Documents

The three columns of statistics show average values for the corpus, consisting respectively of the word count, the Flesch Reading Ease, between 0 and 100, and the Fog Reading Age. A lower Flesch score represents more sophisticated reading. The web articles appear easier to read than the student written sources.

Tables 4 to 6 show the statistics produced by processing the text corpora from Table 3, under the four automated spinning techniques from Table 1.

| | WC | Flesch | Fog |
|----------|-------|--------|------|
| Original | 812.2 | 64.9 | 11.8 |
| Cut | 817.7 | 70.0 | 11.0 |
| Mark | 498.3 | 65.9 | 11.4 |
| Sum | 611.7 | 62.1 | 12.3 |
| Trans | 703.6 | 66.5 | 10.8 |

Table 4 – Effect of Spinning on Ezine Articles Corpus

| | WC | Flesch | Fog |
|----------|-------|--------|------|
| Original | 723.8 | 55.5 | 13.9 |
| Cut | 724.0 | 56.7 | 14.8 |
| Mark | 499.2 | 55.9 | 13.7 |
| Sum | 540.5 | 53.7 | 13.9 |
| Trans | 635.4 | 59.6 | 12.5 |

Table 5 – Effect of Spinning on HCI Corpus

| | WC | Flesch | Fog |
|----------|--------|--------|------|
| Original | 1681.9 | 51.2 | 13.2 |
| Cut | 1693.7 | 54.7 | 12.7 |
| Mark | 505.1 | 50.7 | 13.6 |
| Sum | 1179.9 | 47.5 | 13.8 |
| Trans | 1512.5 | 51.3 | 13.0 |

Table 6 – Effect of Spinning on Research Methods Corpus

The results show some variation between the different corpora. One overall view shows that, with the exception of Cut-Up, all spinning techniques reduce the word count in the spun document. The Flesch and Fog measures do not always agree about the textual sophistication of the new documents. Translation seems to simplify text in every case. The measures for the other spinning techniques vary in both directions.

6. ASSESSMENT OF SIMILARITY

Tables 7 to 10 show the average of the normalised similarity scores produced for each of the twelve spun corpora under the similarity techniques from Table 2. Table 11 shows the results from four overall corpora.

| | TRanker | Ferret | Turnitin |
|-------|---------|--------|----------|
| Cut | 59 | 32.8 | 31.2 |
| Mark | 84.9 | 32.9 | 32.1 |
| Sum | 87.9 | 69.2 | 99.5 |
| Trans | 26.8 | 4.9 | 5.2 |

Table 7 – Average Similarity Scores for Spun Ezine Articles Corpora

| | TRanker | Ferret | Turnitin |
|-------|---------|--------|----------|
| Cut | 47.7 | 19.1 | 57.7 |
| Mark | 51.6 | 13.9 | 26 |
| Sum | 83.8 | 67.1 | 99.3 |
| Trans | 32.1 | 6.1 | 15.3 |

Table 9 – Average Similarity Scores for Spun Research Methods Corpora

| | TRanker | Ferret | Turnitin |
|-------|---------|--------|----------|
| Cut | 52.7 | 21.1 | 15.4 |
| Mark | 75 | 24.1 | 22.5 |
| Sum | 87.2 | 71.5 | 99.6 |
| Trans | 28.6 | 4.3 | 3.4 |

Table 8 – Average Similarity Scores for Spun HCI Corpora

| | TRanker | Ferret | Turnitin |
|-------|---------|--------|----------|
| Cut | 53.1 | 24.3 | 34.8 |
| Mark | 64.8 | 22.5 | 34.6 |
| Sum | 86.3 | 69.3 | 99.5 |
| Trans | 29.2 | 5.1 | 8.0 |

Table 10 – Average Similarity Scores for Spun Overall Corpora

Some trends are clear from the results. All engines produce their highest similarity scores for the Summarisation method. This is perhaps not surprising, as the resulting text contains whole sentences from the original source. The values are all high. This suggests that students cheating in this manner would be caught.

The Cut-Up and Markov Generation techniques produce a wide range of values. Part of this may be due to an inherent randomness in the articles produced. The TRanker word pairs algorithm generally scores these higher than Ferret and Turnitin. It appears uncertain whether students could cheat successfully in these ways.

Translation is of chief concern. Both Ferret and Turnitin barely register a similarity score for these values. TRanker scores these higher, but this may still appear within the region judged by tutors to represent noise. If these engines are taken to represent the ballpark of plagiarism detection as a whole it is likely that students spinning essays using Translation will not be caught.

A final note relating to engines is that Ferret seems to score spun essays and articles lower than the other two engines. It may be that Ferret does a better job of filtering out noise than other engines and so these cheating techniques would also be detected. However, this might also suggest that, whilst Ferret is good at detecting certain types of cheating, a 'one-stop shop' approach to plagiarism detection is not feasible.

7. CONCLUSIONS

The initial tests have shown that automated essay spinning will fool some of the similarity analysis techniques used in plagiarism detection engines today. Whilst Summarisation will likely be detected, the Cut-Up and Markov Generation may fool the engines. Translation will almost certainly fool humans looking at the results from the engines.

This study has not attempted to assess the quality of English produced by each technique. One observation of both Cut-Up and Markov Generation is that some of the rearrangements can make the output non-sensical. These would require more rewriting to be academically submitted. Further studies could investigate the readability of these generated texts.

Of most immediate concern is the Translation technique. Although the level of English produced by this is not always perfect this would not in itself be an indicator of plagiarism. Many students, including international students, produce written work with imperfect English. Perfect English might even arouse its own suspicions. Support services could be unwittingly used to help proof read and improve assignments and only question a student's ability at English, not the originality of work produced. There is already anecdotal evidence that some students are receiving work and dissertations from overseas and translating these to get around anti-plagiarism checks. The evidence presented in this paper, that detection would be unlikely, supports this concern.

The results are only an initial study, looking purely at a small selection of automated essay spinning techniques. Tests on larger samples would be needed to confirm these results further, although even in their absence the Translation result looks convincing.

It is clear that there are other possible automated techniques, as well as some more usually partially automated, such as synonym replacement, which should also be investigated in more depth. Students may further be using combinations of these techniques, or more sophisticated versions operating on only parts of documents, for instance to preserve keywords or citations. These would make observational detection more difficult.

The results motivate the need for continued development of anti-plagiarism software. An avenue for exploration might be to look at the underlying structure of documents, perhaps by converting words to their root forms or looking for underlying ideas. A corpus of automatically translated versions of documents might also be necessary.

The study itself does indicate the need for the UK academic community to continue to monitor how students are cheating and to consider ways to redesign assessments to make them less susceptible to this. The need to detect when essays have been spun should be seen as a last resort.

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TECHNOLOGICALLY ENHANCED DEMONSTRATOR SUPPORT – TOOLS FOR ASSISTING DEMONSTRATORS IN FIRST YEAR PROGRAMMING LABORATORY CLASSES

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ABSTRACT

This paper will introduce the Technologically Enhanced Demonstrator Support or TEDS system designed to provide assistance for demonstrators in first year programming laboratory classes. This paper will present the early analysis of results from laboratory classes carried out using the TEDS system, to see how effective TEDS is at revealing which students' are having problems and directing the demonstrators to these particular students'.

Keywords

Java programming, laboratory classes, teaching aid, student support

1. INTRODUCTION

One typical format for teaching programming at a Higher Education level is through a mixture of lectures supported by practical laboratory classes [1]. This paper will focus on the Introductory Programming course taught at Durham University, which is the first programming course that the students' have in Durham and where they are currently taught the Java programming language. For this course the ratio of lectures to practicals is 1:1 with two one hour lectures and one compulsory two hour practical per week. Practical classes are viewed as where students' are able to put "into practise the theory and strategies that have been taught in lectures" [2]. Postgraduate demonstrators, who are experts in the course, support these practicals. Their roles are to provide assistance to students' with any technical difficulties that they may encounter with the work, and also to monitor attendance.

This paper will discuss the role of the demonstrator as somebody who provides assistance for the students' with their software problems. It will also show the difficulties that they have in providing this assistance and if technology can be used to overcome these issues.

Tools like SNOOPIE [3] have been used to provide extra help for students' in allowing them to get over their own issues within practical laboratory classes. The tool discussed in this paper is primarily designed to provide the demonstrators with more live visibility of a students' progress within a laboratory class to allow the demonstrator to be able to provide more effective assistance.

2. ISSUES WITH THE CURRENT PRACTICAL SETTING

Research was carried out on the existing practical setting at the beginning of the 2008 – 2009 academic year to identify if there were any areas where technology could be used to support the demonstrators.

This study consisted of observations, interviews and questionnaires. The observations looked at how demonstrators and students' interacted together. The focus was put on who instigated the interaction and also how long these interactions were. During these observations the researcher also recorded interesting occurrences, so that they could be followed up with interviews with the demonstrators and also with the students' after the observed practicals. At the end of the observed practical both the students' and the demonstrators were given a questionnaire to fill out to see if they supported some of the preconceptions that the researcher had about practicals and also to see if the responses supported the behaviour that was observed and recorded during the practical.

The first observation that was taken from the two observed practical classes was that demonstrators could be grouped together into two types, which can be termed as proactive and reactive. Proactive demonstrators can be seen to move around the laboratory more, inquiring on progress and trying to view progress by looking over the shoulders of the students'. Alternatively reactive demonstrators were more likely to be found in one spot overlooking the students' and waiting for visual or audible requests from the students' for help. Lecturers who were interviewed said that they would prefer that their demonstrators were more proactive than reactive. They further commented that it is very easy for students' to hide issues that they have with their work in the existing computer laboratories and some students' are liable to just suffer in silence.

Two groups were observed. Group A was the larger group with a ratio of students to demonstrators of 25:3 and Group B had a ratio of 14:3.

In the first group observed (Group A) there were 49 interactions, students' instigated 35 of them and the other 14 instigated by the demonstrators. In the second laboratory class (Group B), there were 26 interactions, 18 instigated by students' and the other 8 by the demonstrators. From these findings it could be concluded that some students' were not that afraid of asking for help, with the higher proportion of student instigated interactions. This although does not give the whole picture. The observations from the researcher noted that interactions seemed to be in the majority by students' catching a demonstrators eye or turning around to talk to one of the more proactive demonstrators as they walked around the laboratory, rather than them openly beckoning over one of the reactive demonstrators. Through these observations it can be seen that at least some students' are afraid to ask for help in practicals.

In interviews with demonstrators they noted another problem was that communication difficulties arose in the laboratory classes due to the layout of the room with the students' always focussing and sat facing their computers. One demonstrator commented, "Currently it is awkward for demonstrators to talk to a student as the rooms are too cramped and the demonstrator will have to talk on their knees or over the student's shoulder". This shows that the room is an issue for communication as well and in further interviews with the demonstrators it was suggested that this could have been the reason for some of the demonstrators being more reactive, rather than proactive, as the rooms are not that conducive to proactive demonstrators moving around the laboratory. These things combine together the room and the reactive demonstrators to make it difficult to track a students' progress and cause communication problems between demonstrators and students' within practicals.

3. RESEARCH QUESTIONS

From the research carried out in the last section three issues/problems that demonstrators have with supporting students' were identified and these are:

- Communication difficulties between the students' and the demonstrators
- Students' being afraid to ask for assistance
- Demonstrators being unable to see how well a particular student is progressing

A tool was developed to assist demonstrators with these issues in mind and that is described in the next section.

4. TEDS

TEDS or Technologically Enhanced Demonstrator Support was designed with the goal of allowing demonstrators to have a better view of how the current class of students' is progressing at any particular moment in time.

The tool is a plug –in for the BlueJ Integrated Development Environment (IDE), which is used at Durham University as their first IDE before they progress onto Eclipse [4] towards the end of the first year.

TEDS is split into two parts: the student client that waits for events by the student and the demonstrator client, which provides a report of the students' events.

4.1 Why BlueJ?

BlueJ [4] was used as the basis for TEDS for two main reasons.

The first is that the students' would be familiar with the system already instead of switching them to a new system for the experiments. This was important as it allows for a fairer test between the practicals surveyed in section 2 and the ones using TEDS. The version of BlueJ that the students' would be using looks and works the same as the one that they use every week.

The second reason for using BlueJ is that it is easy to extend and to add new functions to [5].

4.2 Functionality of TEDS

TEDS has a number of functions that allow demonstrators to be able to assist students' more effectively within a practical setting. They include:

1. Report of students' last compile i.e. success/fail;
2. Report of students' last method invocation i.e. success/fail;
3. A snapshot of the students' code that is sent to the demonstrators;
4. Ability for students' to request help electronically;
5. Ability for demonstrators to reply remotely to students' via SMS (Short Message Service) functionality;
6. Ability for demonstrators to draw and send images to students' to help them understand concepts;
7. Objective setting functionality allowing clear objectives to be set in the practical.

This paper will just concentrate on the first two functions listed and how they impacted on the demonstrators' behaviour and also their ability to be able to assist the students'.

These two functions were added to BlueJ using the extensions builder [6] and works by waiting in the students' version of BlueJ for them to interact with their code in one of two ways; either by pressing the compile button or by running a method within their code. After the student does either of those two interactions the students' client sends a status update message to the server, which then sends the students' status to the demonstrators. If it was a compiler interaction the message contains data informing the demonstrators if the students' code compiled successfully or not, if it did not what the reason was for the compiler error and where in the students' code the error took place. If it was a method invocation the demonstrators are given a report if it was successful or not and no further details.

It was predicted that the demonstrators would be able to see from the amount of compiler errors and the types of errors whether a particular student would require help, which they may at present had not been asking for. These functions were also hoped to allow the more reactive demonstrators to see that some students' required help without the need for them to wait for the students' to visually ask for help i.e. put their hands up. Also with the tool reporting every action performed by the students', periods of inactivity from the students' can be detected and the demonstrators can perform investigations to see the reasons for this. For example, if the students' had encountered a problem they may spend time looking at their code puzzled over how to proceed and after a amount of time of no status reports from the students' the demonstrators may decide that intervention would be helpful.

5. EXPERIMENTS

Experiments with the tool began at the beginning in December of the 2008 - 2009 academic year and went on through to February 2009. They took part in the two practicals that were used for analysing the current practical setting in section 2. The technologically enhanced practicals were designed to be as similar to the usual practicals as possible for the students'. The only real difference that the students' would see is that the demonstrators now had tablet personal computers, which run the teachers client of TEDS that received and presented the students' status reports to the demonstrators. With this design of experiment it was expected that the students' themselves would not notice much difference in the way that they work in the practical.

The experiment was done using a form of participant observation, where the researcher took the role of a demonstrator along with the other demonstrators. Questionnaires were given to both demonstrators' and students' after the practical to gain their opinion on the system and lastly interviews with the demonstrators were completed.

5.1 Results

In the technologically enhanced practicals the students' were observed to act as usual and with the software running in the background the results that came from the students' were interesting.

5.1.1 View of Students' Compiler Success

Figure 1 shows one students' compiler progress over the course of one of the observed practicals. You can see here that with this student the status updates could indicate a couple of occasions where demonstrator interference may have been good for the student to help them to progress.

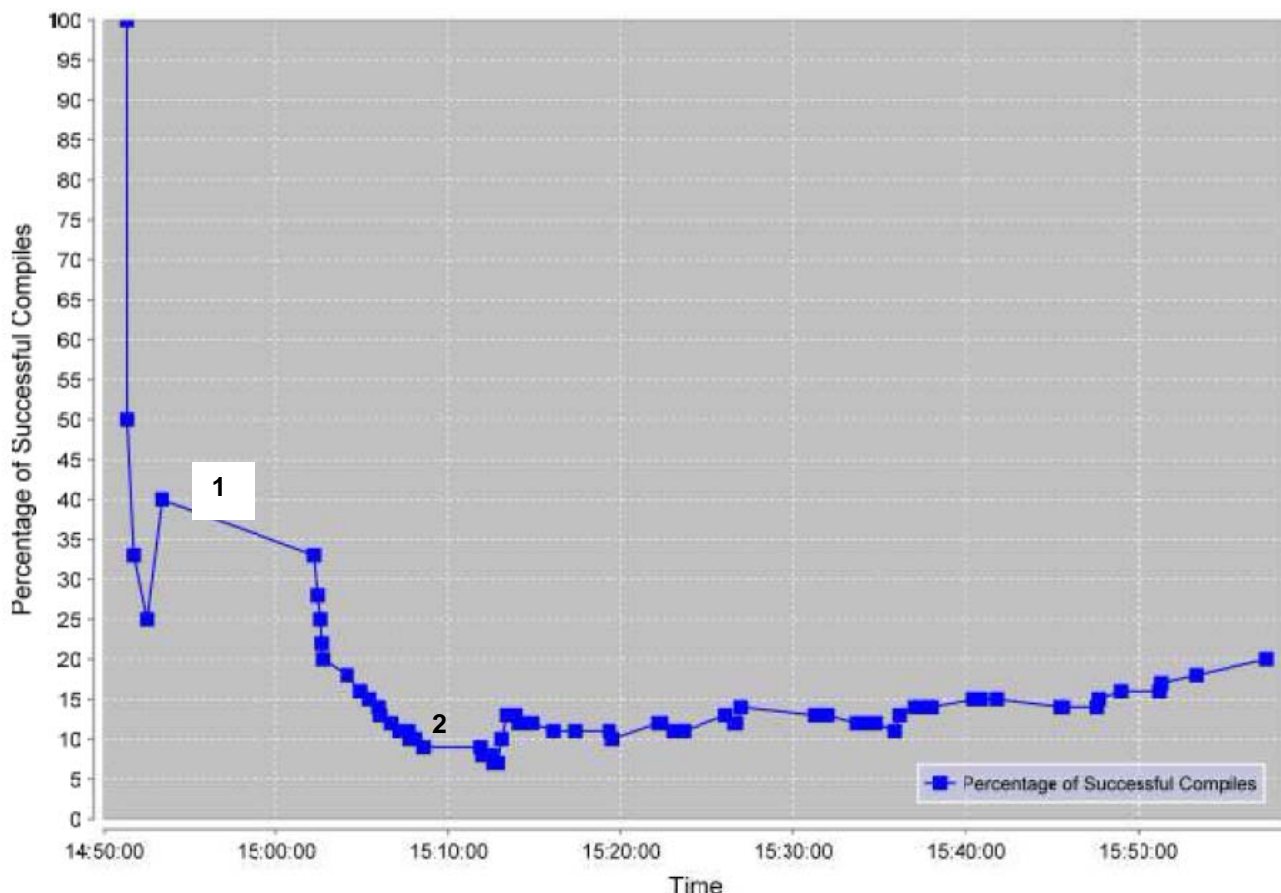


Figure 1 – Example of students' percentage of successful compiles over the course of a practical

At point 1 the student shows a gap of around 10 minutes between compiles. This could show a number of things for example that the student is researching how to do the next thing they have to do. It can be noted that the last compile before the gap was successful, yet they may require advice here on how to proceed. At point 2 it can be seen an element where the student after a number of compiler failures has a gap where they used some of TEDS functionalities to contact the demonstrator but it also shows where a demonstrator could see that a student was facing difficulties. As the graph shows after the demonstrator's intervention the student steadily worked on their code without any prolonged semantical issues.

With this functionality we were looking to see if the less active demonstrators were more likely to go and approach students' who seemed to have more compiler errors. This was the case in a number of situations within the technologically enhanced practicals where reactive demonstrators were seen to be a little more proactive within the class. One example in particular saw a reactive demonstrator go to a student who had been consistently compiling unsuccessfully and then after the intervention they began being more successful. Also from observations the demonstrator then seemed to spend quite a lot of time observing that particular student, both electronically and physically. It seemed that by the students requesting help from the demonstrators unintentionally through the mistakes that they make, that the more reactive demonstrators became more proactive responding to the status updates as cries for help.

All of the demonstrators who used the system commented in their questionnaires that they agreed that the system was beneficial to their ability to help the students', and also their ability to be able to see which students' were having problems in the lesson. In interviews with some of the more proactive demonstrators they commented that the system had limitations as between going to see students' and walking around the

class they did not feel like they had the chance to really check the reporting systems. This was due to the way they usually monitored the class meant that they were almost continually occupied with talking to students'.

5.1.2 Description of Students' Errors

TEDS also sends over a report of the errors that the students' commit when they compile. In the experiment this was not used as much as the current compiler status data, but was shown to have some interesting results. This live data allowed the demonstrators to see what the high concentration of errors were and from there the demonstrator can see further what the individual students' had as their main errors, so that they can then offer assistance on how to avoid these errors. The demonstrators once again said that they liked this functionality and one mentioned how they would like the errors to be classified to see at what level students' who committed those errors are usually at. This is so that the demonstrator would be able to judge by the errors what level the students' are at straight away in the practical, by the errors that they were committing. This suggestion moves more towards Jadud's research where he catalogues novice compiler errors [4].

Also another benefit is that the system can provide an overall record of the students' errors within the practical. This means report to the lecturer of the module so that they can tailor a section of the next lecture on dealing with or avoiding these types of errors.

5.1.3 Method Invocation Data

TEDS ability to be able to track the success or failure of each method invocation by the students', was not as successful as the compiler detail information. It allowed the demonstrators to be able to see if the students' were able to run their code successfully and furthermore to see if there were any periods of inactivity, but unfortunately TEDS do not pick up some run time errors.

TEDS is able to pick up some run time errors like null pointer exceptions, yet run time errors where the students' method runs but does not do what they were trying to do, are not picked up by the system. In these cases the status updates received by the demonstrator would actually say the method worked successfully.

In interviews the demonstrators did not really talk much about their use of this particular function.

To make this function more useful a way of allowing students' to manually say that their method ran successfully would overcome these problems. Another way would be to integrate J-Unit tests into TEDS.

6. CONCLUSION AND FURTHER WORK

From this early analysis of the data recorded from the students' compiles within practicals and the questionnaires from the students' and the demonstrators, there is indication that the compiler data from the students' can be used within practical laboratory classes to enable demonstrators to be able to assist the students'. It also appears that TEDS can work in some ways to be able to counter some of the drawbacks of practical laboratory classes such as the room layout not allowing demonstrators to be able to track progress, the unwillingness of some students' to openly ask for help and communication difficulties that result from these two.

Despite these early positive findings further analysis still needs to be carried out on the two functions examined in this paper and also the other functions mentioned in section 4 to look in to how beneficial or not, TEDS is for demonstrators in practical laboratory classes.

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EVOLUTION OF AN INDUCTION PROGRAMME

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ABSTRACT

The Bootstrap Programme is a department-specific induction programme that has run for three years. Initially Bootstrap was a short programme used to help students get to know their peers and a few members of the lecturing staff. The programme was designed to provide students with a degree of comfort in their new learning environment. The induction programme has evolved into a programme that is also intended to help students to better understand what computer science is and how the department's research will enhance their degree.

Keywords

Induction, First Year Experience

1. BACKGROUND

At Durham University we are fortunate to have a college system that provides students both undergraduate and postgraduate with a small community within the larger institution. As new students arrive they are welcomed into an established community. Traditionally, departments took little time to acclimatise new students assuming that they would adjust once lectures and, in the case of sciences subjects, labs began. Until academic year 2006/7 our department's induction effort for new undergraduates were comprised of two events: a formal lecture to new students to outline first year course details, progression routes, and rules surrounding administrative issues for example assessment submission and illness; and an informal social where staff and new students chatted casually over drinks and snacks.

Results from: surveys conducted by the department and the Centre for Excellence in Teaching and Learning: Active Learning in Computing (ALiC); focus groups hosted by ALiC; and informal discussions with students; all indicated that students did not feel a sense of belonging to the department until level-two group-project was underway. As a consequence our department's level-one students often felt they were not sufficiently supported by the department. Additionally, students felt it took a long time to get to know a few peers and some students still felt isolated from their academic peers by the end of their first year of study. ALiC was concerned about these findings and wanted to find ways to help new students find a sense of belonging to the department as a learning community. We were aware that one of the reasons students valued the second-year group-project was that students finally got to know their academic peers. Students had the opportunity to work collaboratively on the group-project and to form groups to study cooperatively on formative and summative work not associated with the group-project [1]. As part of the remit of ALiC a new and innovated learning environment specifically designed to support group-work has been built. The environment, the Techno-Café, provides an ideal venue for any group-work [2]. The Techno-Café contains 10 individual booths in which teams can collaborate and share technology. ALiC exploited this environment, usually used for team work, to host an event designed to help students become acquainted with their peers by putting them into groups and assigning each group to a booth.

Cook et al [3] through work in the Student Transition and Retention (STAR) project have defined induction as a long process intended to help students through all phases of transition in their undergraduate experiences including the transitions from: secondary to tertiary education, work to tertiary education; lower to higher levels within the degree programme; from internship or work placements back into an academic setting; and finally from tertiary education to the next phase of the student's life, be that postgraduate study or employment.

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They describe a process of progression that begins with an initial welcome programme but then continues throughout the students' experiences in Higher Education encompassing curriculum elements, and departmental and institutional support services. We do believe that our institution as a whole is working to achieve support for all the transition in the undergraduate experience of tertiary education. However, ALiC's goal here was to explore ways to increase the contribution of the department in supporting students in their transition from secondary to tertiary education.

2. DEPARTMENT SPECIFIC INDUCTION

It was decided that ALiC would organise and run a department-specific undergraduate induction event in academic year 2006/7 with two main goals: to help students get to know their peers, and to get students comfortable with working with peers to achieve a learning objective. ALiC would incorporate the two existing events into the schedule. In addition, ALiC would design and run social based events to encourage students to get to know each other and a team based event to demonstrate what could be achieved with peer support.

The new induction programme required that the students' timetable would accommodate the inclusion of three 2-hour sessions. As there are no labs in the first week of a new academic year ALiC was able to find the necessary space in the students' schedule.

2.1 Social Sessions

To facilitate the introduction of students to each other we put students into groups. We determined the groups ourselves. The intention was to ensure that students in the same college did not get assigned to the same group. To get students to get to know the members of their new group we organised two short icebreaker activities. First we instructed students to introduce themselves using a round-robin each student in turn had to give their first name and one fact about themselves. It was observed that about five minutes into the first icebreaker activity students abandoned the round-robin and began having conversations, usually about things they had discovered they had in common. As this was the goal we allowed a light conversational buzz to grow for another 5 minutes before moving on to the next icebreaker activity.

For the start of the second icebreaker activity and the remainder of the programme groups were referred to as teams. The term team infers a shared leadership [4] as well as kindle an atmosphere of friendly competition. The next icebreaker activity was the creation of a poster with images to represent each member of the team restricted to the category provided by ALiC. Categories were different for each team and covered areas where there would be a good number of images available free on the Internet for example birds. Each team developed a poster and then all teams wandered around the room looking and commenting on other teams' posters. This activity generated a lively discussion and was successful in getting students to move around room chat to students in other teams thereby becoming familiar with a few more of their peers.

At Durham University departments share centrally booked lecture theatres, labs and teaching rooms. Buildings are known by the department offices for example the Physics building or by the name of a famous person for example the Dawson building. Helping students to find their way around the campus is an essential part of any good induction programme [3]. The majority of lectures for science subjects are held on the Science Site campus which is the campus where the Techno-Café, and therefore the induction programme, is located. The final part of the first session was a treasure hunt. The treasure hunt was designed to guide the students around the science site to the lecture theatres and labs that they were scheduled to use in the first term. To start the treasure hunt teams had to correctly complete a short quiz containing questions about the university, the department's staff, and computer science. All answers were readily available on the web. Once a team completed the quiz they were given a list of questions about the campus to answer, a route to follow to find the answers and their start time was recorded. To ensure that everyone eventually comes back there must be a maximum time limit on the treasure hunt. As we encouraged a spirit of competition there needed to be prizes and time allocated to the prize giving ceremony. Teams found their way around the campus and individuals located useful landmarks.

2.2 Teamwork Sessions

The next two sessions required teams to compete by re-engineering an ailing business' use of technology. Staff had a good time developing the world's worst website. Early staff/student interaction will help students make the transition to tertiary education [5]. To enable that interaction the level-one lecturing staff participated in the ailing business sessions firstly by adopting roles as employees of the ailing business who could be interviewed about the business. The first of the two sessions was scheduled for students to get their ideas

together and the second session was when the teams presented their ideas to the customer. The presentations were done in the booths of the Techno-Café to ensure that all students would be relaxed and willing to participate in the presentation. It was decided that it was too early in the academic year to subject students to the stress of formal presentations. Though the presentations were strictly timetabled the staff and students' enthusiasm meant that the timetable was completely ignored. The goal of getting students to work in teams was clearly achieved. Staff enjoyed the role-play and the chance to get to know the students early in the academic year. Post-event focus groups indicated that students wanted to meet some staff but not too many of them.

2.3 Closing Survey

At the conclusion of the induction programme a survey was distributed to the students to elicit their views on the programme. As we had run over our time some students did have to leave to attend lectures for optional modules outside the department and were unable to complete the survey. The survey showed that students enjoyed the opportunity to get to know their peers and enjoyed the time spent in the induction programme. 36 of the 55 students completed the survey. 11 students strongly agreed with the statement "I enjoyed getting to know other students", 24 agreed and one was neutral. 3 students strongly agreed with the statement "I enjoyed induction", 26 agreed, and 7 were neutral. When asked for comments most students wrote statements of gratitude for the snacks and drinks provided throughout the programme. It was these comments that prompted the first reflection that perhaps the event had been too focused on fun and not sufficiently on the transition in to tertiary education.

3 THE BOOTSTRAP PROGRAMME

A good induction programme will have a positive impact on the students' first-year experience within the department [3]. Analysis of our induction programme and subsequent discussions between ALiC and first-year teaching staff in the department revealed that it would be desirable to have an induction programme which would go beyond the social aspects of helping students to get to know their peers and also concentrated on providing students with the opportunity to gain insights into both their individual learning style and the active learning pedagogy used in learning about Computer Science. The Bootstrap Programme emerged from the re-design of the initial induction programme and was delivered by ALiC the first week of the academic year 2007/8. Bootstrap was a richer induction programme and required the entire first week of the teaching allocation including lectures and labs. Bootstrap included the successful social session and teamwork sessions from the original induction programme. Added to the programme were a team programming session; a series of one-hour workshops called learning labs; and random surveys to allow staff to learn about the new cohort of students.

3.1 The Team Programming Session

In the team programming session each team was given two different graphical programming languages: a two dimensional and a three dimensional language. Teams were directed to compare the languages and then select one with which to develop a short program. The task gave those students in the team with strong programming skills the opportunity to display their skills while students who had not as yet learned to program were encouraged to participate in the comparison of the languages and then apply their creative ideas to the development of the graphical program. The adoption of "NetSupport School" classroom management software in the Techno-Café meant that we now had the ability to display the same object on all the Techno-Café's networked interactive-whiteboards simultaneously. Rather than walk around to see other teams' programmes, all of the programmes were collected and run a central computer that broadcast each program to the interactive whiteboards in each booth. The ability to show the work on all the interactive-whiteboards simultaneously made for a competitive and funny session. There were no clear indicators, in surveys or student achievement, of whether or not the group programming exercise aided in learning programming. However, observations in programming labs later in the academic year did indicate greater peer interaction. Results from post-event focus group confirmed that students found that the session did help them identify a few good programmers they felt sufficiently at ease with to ask for help.

3.2 The Learning Labs

ALiC developed three one hour workshops called Learning Labs. These short workshops were designed to encourage students to think about learning and how to go about learning successfully in Higher Education. Students participated in interactive lectures and exercises to explore: different learning styles; different approaches to learning; and active learning techniques. In addition, to the workshops students were encouraged to discover their own learning style using a free on-line quiz available through the "VARK A guide to learning styles" and review the accompanying on-line aides "Study Without Tears" [6].

3.3 Closing Survey

At the conclusion of the Bootstrap programme a survey was distributed to the students to elicit their views on the programme. Fifty-two students completed the survey. To the statement "I enjoyed getting to know my fellow students" 18 students strongly agreed, 33 agreed and 1 disagreed. To the statement "I enjoyed the Bootstrap programme" 42 agreed with the statement, 8 disagreed and 2 strongly disagreed. One of the students who did not like the program did provide a comment "*coming in to Uni after months of doing nothing I just wanting to start to work*". When asked which session they enjoyed the most the responses were fairly evenly distributed between the treasure hunt, the programming session and the ailing business session. The general comments focused on ways we could improve the programme for example moving students into different teams more often to allow them to get to know more of their fellow students. There were a few negative comments about the learning labs. There was some hope that the content of the workshop would be better appreciated after students had struggled there way through a few weeks of lectures and labs. However, though the workshop slides remained available for the remainder of the academic year and they were not accessed by any of the students.

4 EMBEDDING THE BOOTSTRAP PROGRAMME

It is the remit of the CETL to embed in departments and institutions those practices and concepts that have been shown to enhanced the teaching and learning experience of students and staff. The Bootstrap Programme was recommended and accepted for embedding in the department in academic year 2008/9. ALiC staff would play a role in the Bootstrap programme but instead of running the programme their role would be equivalent to that of any member of the department in the next iteration of the Bootstrap programme. Embedding the programme in the department's usual practice did not mean that the programme would remain unchanged. The programme was adapted to support current department's initiatives. Most Computer Science departments struggle with getting a new intake of students to grasp what Computer Science is [7]. Students are rarely aware of the breadth of the subject and do not comprehend the research areas under investigation by staff. The department decided to make changes to the Bootstrap Programme that would help students to better understand what computer science is and how the department's research will enhance their degree.

4.1 Changes to the Programme

The treasure hunt that was designed help students find their way around the campus was replaced by a team-quiz that was designed to demonstrate the breadth of computer science as an area of research with an emphasis on those topics that would be covered in the level-one syllabus. The teams were very competitive and it was a lively session. There was no proof that the students had grasped the objective of the quiz. There was a competitive atmosphere to the quiz where the focus was on winning rather than learning.

ALiC had determined that the scenario being used in the ailing business sessions had been used enough and either a new scenario would have to be developed or the two sessions would have to be replaced by new activities. The department decided to replace the two sessions with new activities. To increase students' awareness and understanding of the research being undertaken in the department the staff were invited to showcase their research one afternoon during the Bootstrap Programme. Staff either gave short talks or demonstrations. The Technology Enhanced Learning (TEL) research group demonstrations proved to be the most popular because students could if they chose become involved in the research. TEL provided tours of their labs and then gave students PDAs with the most recent version of Technology Enhanced Campus (TEC). TEC is a research project being undertaken to discover means of using mobile technologies to support the collection and distribution location-specific information that will be of interest to the specific receiver. Students were encouraged to take a PDA then to try out the applications as they were sent to them.

In 2008 ALiC hosted a series of focus groups with final-year students. The focus groups were designed to give students an opportunity to reflect on their experiences as undergraduate in the department. One of the insights gleaned from the focus groups was that students believed their initial fear of the mathematical components of the degree proved groundless. The students believed that staff, particularly those who taught and researched in Computation Theory should make more of an effort at the start of the degree programme to demonstrate to students how the mathematics was learnable and not to be feared. ALiC passed the recommendations on to staff researching in the Theory of Computation. The staff rose to the challenge and developed a new session intended to introduce students to relevant areas of mathematics by engaging the teams in a series of mathematical based tasks. The session proved lively with staff working with individual teams to raise the students' awareness of discrete mathematics relevant to their undergraduate degree. The

session was further supported by the research talks from the Theory of Computation researches in the research session of the programme.

5 THE FUTURE

5.1 The Bootstrap Programme

The most readily observable benefit of the Bootstrap Programme has been the earlier interaction between students and their peers in first-year labs where they can be seen working together and only requesting help from staff when their group of peers have exhausted their knowledge and skill. There has also been a rise in the number of questions asked by students in the first-year lectures. Additionally, informal discussions with students point to a sense of belonging to the department surfacing in the first year of their degree. There has been no attempt to formally measure whether or not there has been an improvement to students' understanding of computer science as a discipline and a research area. However, there is a general feeling among staff responsible for lecturing on first-year modules is that the Bootstrap Programme is worth running. There are now changes expected to the Bootstrap Programme for academic year 2009/10.

5.2 Postgraduate Induction Programme

At present the Computer Science department runs three one-year Taught Masters programmes. The department has always run a department-specific induction programme for postgraduates enrolled on the programmes. The focus of the induction programme is to ensure that the department delivers to the postgraduates all the information surrounding the academic and administrative rules of our institution. In academic year 2008/9 ALiC reviewed copies of presentation slides and handout from previous years programmes and determined that the amount of information delivered to the postgraduates was prohibitive. ALiC determined that students need to be made aware of the categories of information available to them and the department then needed to provide a central store for the information. An area on the University's virtual learning environment (VLE) was made available for storing and accessing information usually given to postgraduates. The induction programme for 2008/9 was altered to provide postgraduates with the knowledge about where to find information and detailed information on key issues for example plagiarism and individual project work. To complete the review a member of ALiC participated in the 2008/9 induction programme. Recommendations based on the participation have been presented to the Director for Postgraduate Studies. These recommendations include giving the postgraduates helping the postgraduates feel at ease with lecturing staff by arranging for more of the lecturing staff to participate in the induction programme. Additionally, it has been recommended that the department acknowledge that the postgraduates will have difficulty remembering where to find administrative information until they have a problem for example they need an extension because of illness. It is therefore recommended that the information be organised by problem, what to do if you are ill, as well as solutions (extension request forms). The altered postgraduate induction programme will run in academic year 2009/10. Further reviews are being considered.

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DEVELOPMENT OF A SELF-PACED DISCRETE MATHEMATICS INTERVENTION FOR 'AT RISK' FIRST YEAR COMPUTER SCIENCE STUDENTS

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ABSTRACT

*This paper describes the development of a self-paced discrete mathematics intervention for weaker first year computer science students at a UK university based on a successful self-paced learning course at another UK university. The intervention programme is then introduced as part of the **sigma** Centre for Excellence at the current university. The development of the module and its associated teaching method at the former university is then described. The development of a new intervention based on the teaching method and resources at the former university is discussed. The evaluation of this initial intervention is then described. Funding was received from JISC to develop and Quality Assure these materials. The process of this development and evaluation are described. Finally, conclusions are drawn on the end product of this development work.*

Keywords

Self-paced learning; discrete mathematics; 'at risk' students; teaching interventions; multi-media resources; web-based

1. INTRODUCTION

The need for first year Computer Science students to be taught discrete mathematics has long been argued [1]. Coventry and Loughborough Universities have a proven track record in providing mainly reactive mathematics support to students studying science-based courses. Their experience led to their award of a Centre for Excellence in Teaching and Learning in 2005 which received funding for five years [2]. Their Centre, called **sigma**, is based in the Mathematics Support Centre at Coventry University and the Mathematics Education Centre at Loughborough University.

As part of its activities, **sigma** instigated a Proactive Teaching Programme at both Universities [3]. The aim of this programme is to target "at risk" students on different service mathematics modules and provide them with appropriate proactive support in order to reduce failure rates and hence improve retention rates. The interventions differed in length and teaching style and were either supplementary to the main cohort's provision or replaced it. One of the interventions run within the programme was in discrete mathematics for first year computer science students. From 2006-2007 this intervention was run using a variant of the Computer Assisted Programmed System of Instruction (CAPSI) module at Brunel University applied a group of 'at risk' students within the cohort. The nature of the CAPSI method and its modification to fit in with this context is described in Sections 2 and 3. The evaluation of the 2006-2007 intervention is given in Section 4.

The Programme experienced mixed success in its first two years so it was decided that it should spend the third year mainly developing new resources in order to provide better interventions in the final two years of the **sigma** project. This coincided fortuitously with a JISC call to reuse and repurpose learning resources in Higher Education (HE) called RePRODUCE (Re-Purposing & Reuse of Digital University-level Content and Evaluation) for which **sigma** was successful in winning funding [4]. This enabled them to invest in reusing, repurposing and developing new resources as described in Section 5. The evaluation of the teaching intervention using these new resources is given in Section 6.

Finally, Section 7 draws conclusions on the utility of the CAPSI method, the variant of CAPSI used within the Proactive Teaching Programme, and the resources associated with the method that have become available to the UK HE community through the JISC project.

2. BACKGROUND: THE CAPSI METHOD AT BRUNEL UNIVERSITY

PSI stands for Programmed System of Instruction. It is also known as the Keller Plan [5] which was originally based on the behaviourist theory of positive reinforcement. The basic elements of this method are:

- The module is split up into learning units
- The students are divided into small groups led by student proctors (i.e. students from a higher year of study in the institution)
- Students are provided with paper-based notes covering each unit and work entirely at their own pace
- When a student has read the notes they take a paper-based test
- The proctor marks the students' work immediately and provides them with feedback. If they have achieved a high level of mastery (e.g. at least 80%) they are given the notes for the next unit and allowed to proceed. If they haven't achieved they are directed back to the learning unit for further reading.
- Lectures are provided mainly for motivational purposes

Research indicates that PSI can be very effective [6]. However, known problems are:

- Student reluctance to engage with the method and take the tests
- Over-individual approach to learning
- Limited class size - proctors can typically only handle 15 students at most

CAPSI stands for Computer Assisted PSI. It was developed over 25 years at Brunel University for teaching discrete mathematics to first year computer science students [7]. Their decision to augment self-paced learning with video and computer-based learning was based on evidence that is particularly appropriate for this subject [8].

In CAPSI, student proctors are replaced by postgraduate students and the paper-based notes are augmented with additional video-based teaching resources comprising of a summary of each learning unit and solutions to individual exercises within each learning unit.

The paper-based tests are administered less regularly and are augmented with on-line unit tests delivered within a virtual learning environment (VLE). The paper-based tests are administered at the end of blocks containing approximately 5 learning units. This combination works well because it is more efficient (allowing the groups to be much larger – up to 30 students) and less threatening to the students who receive basic feedback anonymously via the computer. They can also work collaboratively and learn from each other. The feedback from the paper-based tests provides a deeper interaction and encourages engagement with the learning material. In addition, two small group projects were set to enhance student interaction.

All the materials were based on an excellent student-centred textbook [9].

The use of a VLE also provides other forms of learning interaction:

- The paper-based notes are available online and are released incrementally as students attempt the on-line tests, allowing e-learning without attending class
- The module leader hosts an academic discussion board in which instructors answers individual students' questions for the benefit of the entire cohort

3. DEPLOYMENT OF THE CAPSI METHOD AT COVENTRY UNIVERSITY

The CAPSI method was deployed at Coventry University in 2006-2007 as part of **sigma**'s Proactive Teaching Interventions Programme [2] which targets support to 'at risk' students mathematics modules in order to reduce failure rates, many of whom only had a GCSE grade C in mathematics. The subject and student group were the same as at Brunel University. However, the module ran for the whole academic year and covered a more extensive syllabus.

A group of 22 students were selected by a diagnostic test with another 5 added by self-selection. They were taught by the author using the CAPSI method. The contact hours comprised to 2 hours of a combination of lab work and paper-based tests. Students were permitted to attend the main lecture if they wished.

A mobile 'phone SMS service was also provided for the group. Most students had a mobile phone and provided their number. This was used for 'pastoral' messages to encourage dialogue and attendance with messages sent to each student on average once every two weeks.

In the end, due to resource constraints, it was decided to only produce tests for the first two blocks (10 units).

4. EVALUATION OF THE 2006-2007 INTERVENTION

The module drop-out rates for the streamed students was lower than that for the main cohort and also than that for the students in the main cohort taking the same course (Computing & Networks) – see Table 1. This may have been due to the consistent use of SMS messaging for pastoral student support, which was appreciated by the students. Student feedback also indicated that the on-line tests were popular: the students were disappointed that they did not cover the full syllabus. The third block on proof was found to be particularly hard. This was consistent with the module lecturer's experience and also the experience of the textbook's author [10].

| | Type of students | No. students | Average mark | Pass rate | Module drop-out rate |
|--------------------|----------------------|--------------|--------------|-----------|----------------------|
| CAPSI Group | Streamed | 22 | 45% | 55% | 18% |
| | Self-Selected | 5 | 45% | 20% | 0% |
| Main Cohort | Computing & Networks | 65 | 45% | 57% | 26% |
| | All | 129 | 48% | 60% | 22% |

Table 1: Summary of results for CAPSI group in 2006-2007

From the free comments provided in the evaluation there was little evidence that students objected to being singled out for remedial support. However, several students objected to the teaching method adopted and wanted to be taught in a more traditional way. This led to a change in the group selection process in 2007-2008 which allowed the class to run as a voluntary 1 hour supplementary group to the standard lecture and tutorial with the diagnostic test acting as advisory rather than for streaming. The paper-based tests were administered to the whole group at the same time by negotiation. The harder material on proof was moved to a separate block at the end of the module along with some supplementary material.

5. THE JISC REPRODUCE PROJECT

In 2008 **sigma** received £25k funding from JISC for a project under the RePRODUCE funding call entitled *Proactive Maths Support* [4]. The primary objective of this Project was to reuse, repurpose and develop new material in discrete mathematics for first year undergraduate computer science students.

| Block | Unit |
|----------------------------------|--|
| 1: Propositional Logic I | 1: Statements and connectives |
| | 2: Logical equivalence, tautologies and contradictions |
| | 3: Implication |
| | 4: Further logical equivalence and the biconditional |
| 2: Propositional Logic II | 1: Rewriting algebraic and logical expressions |
| | 2: Valid arguments |
| | 3: Argument forms, compound arguments and fallacies |
| | 4: The deduction theorem and introduction to quantifiers |
| 3: Data Structures I | 1: Sets – introduction |
| | 2: Sets – further concepts |
| | 3: Relations |
| | 4: Functions |
| 4: Data Structures II | 1: Equivalence relations and congruence arithmetic |
| | 2: Matrices and relations |
| | 3: Graphs |
| | 4: Trees and coding |
| 5: Algorithms | 1: Algorithms and their efficiency |
| | 2: Algorithms for graphs and networks |
| | 3: Searching and sorting algorithms |
| | 4: The Huffman code and cryptography |
| 6: Extension Material | 1: Quantifiers |
| | 2: Arguments involving quantifiers |
| | 3: Sequences and induction |
| | 4: Proof methods |
| | 5: Algorithm correctness |

Table 2: Syllabus of the JISC project Resources

The learning content the Project planned to reuse was the self-paced learning discrete mathematics material from Brunel University discussed in Sections 3 and 4. Some work had already taken place to upgrade and extend these materials to cover the Coventry University syllabus but much more work was needed. The syllabus was reorganised slightly into 6 blocks of 25 units as shown in Table 2 with more support resources being provided on basic logic and the harder predicate logic being moved to the extension material in block 6.

The format of the videos was changed to wmv and the summary videos were split up into shorter sections. The materials were also quality assured. In the end, the paper-based notes were produced to cover the whole syllabus but the videos and online tests were only completed for the first 5 blocks.

The new materials were implemented in the 2008-2009 intervention as part of the **sigma** Proactive Teaching Programme. This was run in a similar format to the previous year.

6. EVALUATION OF THE 2008-2009 INTERVENTION

The effect of the 2008-2009 intervention was evaluated quantitatively by comparing attendance at the support sessions against marks for the first coursework exam. In order to measure the added value of the intervention, these marks were also compared against diagnostic test marks.

There was a small positive linear correlation (3.2%, t-statistic < 0.001) between attendance at the support classes and the students' first coursework mark, suggesting that the support sessions were slightly beneficial to the students.

Comparing module marks for students who had achieved the same diagnostic test score and those who did or did not use the support suggested that the support was of benefit to students who were less well-prepared. Of the 15 students had achieved 40% or less in the diagnostic test, only three attended the support sessions. However, all three passed the first coursework exam. Conversely, out of the remaining 12 students who did not use it, two failed the coursework. For the remainder of the cohort there was little difference between the module grades of students who had or had not used the support by comparing students with the same diagnostic test score.

Feedback was also gathered from a questionnaire which was administered in 3 different formats, from which 20 responses were collected. In addition, brief semi-structured interviews were held with 6 students who had attended a support class.

Several questions related to how useful the students found the **sigma** resources provided in the intervention. Table 3 gives the number of responses in each category. The most useful forms of support appear to be the **sigma** notes, the **sigma** tutor support and the videos. The relative popularity of online videos over lectures in undergraduate physics education was established in another recent study [11].

| Main Provision | | Very Useful | Quite Useful | A little Useful | Not Useful | N/a |
|------------------|------------------------------------|-------------|--------------|-----------------|------------|-----|
| Sessions | <i>Lecture</i> | 5 | 4 | 11 | | |
| | <i>Tutorial</i> | 11 | 7 | 2 | | |
| Resources | <i>Lecture notes</i> | 3 | 9 | 3 | 5 | |
| | <i>Recommended text book</i> | 2 | 4 | 2 | 2 | 10 |
| sigma Support | | Very Useful | Quite Useful | A little Useful | Not Useful | N/a |
| Session | <i>Tutor support</i> | 9 | 5 | 2 | | 4 |
| Resources | <i>sigma notes</i> | 10 | 8 | 1 | | 1 |
| | <i>Recommended sigma text book</i> | 1 | 2 | 2 | 1 | 13 |
| | <i>Videos</i> | 6 | 2 | 3 | 1 | 8 |
| | <i>Online tests</i> | 2 | 9 | 2 | 1 | 6 |
| | <i>Paper tests</i> | 4 | 4 | 8 | 1 | 3 |

Table 3: Evaluation of the 2008-2009 intervention

Perhaps more importantly, the qualitative data highlights how valuable the students found the support. All responses to the questionnaires were extremely positive with 90% of the responding students indicating that they had felt that the support was worthwhile. Indeed, the majority of responding students had found the support sessions and materials more helpful than the main provision. Analysis of the interview data indicated that the support was particularly successful in motivating and engaging students and that without it the students might have been susceptible to disengagement. Indeed, the students felt that having a mixture of

resources at hand (including one-to-one support) and being encouraged to attend the sessions via text messages had helped motivate them. This, in turn, increased feelings of confidence amongst responding students, all of whom had felt that the support had been beneficial.

These findings suggest that the support is a worthwhile exercise. Not only can regular attendance help to improve pass rates amongst mathematically less well-prepared students, but the support is also invaluable in helping students cope with the module. In addition, there were a number of students who did not use the support but were clearly in need of it (since they had failed the first coursework). It is also suggested that further action could be implemented to encourage these students to engage with the support on the outset.

7. DISCUSSION AND CONCLUSIONS

The CAPSI method for teaching discrete mathematics to first year Computer Science students at Brunel University has been proved effective by being accepted as part of their educational provision for the entire cohort for many years. The adaption of the CAPSI method for 'at risk' Computer Science students at Coventry University has worked best as a supplementary class with the initial diagnostic test being used as advisory rather than for streaming students. On the downside, as with most other interventions in the Proactive Teaching Programme, the inability to give marks for engaging with the intervention resources was a disadvantage as a critical factor affecting student engagement is getting them to take the formative paper based tests.

The development work at Coventry University under the JISC RePRODUCE project has resulted in a resource-based module in discrete mathematics becoming available to the UK HE community comprising of 182 video clips in wmv format, 25 units of paper-based notes and 20 online tests. These will be available to the UK HE community via the JorumEducationUK repository, which is due to come online in August 2009 [12]. These materials have been quality assured and trialled out for 3 years with 'at risk' students at Coventry University as part of **sigma's** Proactive Teaching Programme with generally positive results. The resources provided can be tailored to suit other institutional contexts. The paper-based notes and online tests are both provided in formats which allow them to be repurposed for use in other institutions. The videos are sufficiently modularised for users to select which ones they find appropriate.

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THE INNOVATION BANK: PROJECT GROUP FORMATION AND MUCH MORE

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ABSTRACT

Group project work for final year students at Leeds Metropolitan University has been supported in 2008-9 in a way different from that of previous years. The aim has been to use technology in the form of a customised web-based application to facilitate the processes of group formation and project management, to encourage employer involvement and to improve employment prospects for students. This paper discusses the extent to which these aims have been achieved.

Keywords

groupwork project group formation employment

1. INTRODUCTION

During their final year, the undergraduates within Innovation North (the Faculty of Information and Technology) at Leeds Metropolitan University undertake a substantial project, usually working collaboratively within small groups. The Faculty has been increasing its use of group and project work in the final year of the degree, as well as endeavoring to ensure that as many projects as possible have links to the real world. This strategy aligns closely with the aims of the Centre for Excellence in Teaching and Learning – Active Learning in Computing (CETL ALiC) [1], in which Leeds Metropolitan is a partner.

In 2008-2009, the process of organising final-year projects has been supported in a way somewhat different from that of previous years. With more than 700 students involved, the process of disseminating ideas for projects (which could be generated by tutors, students, or outside employers) and linking the students in small groups to these projects is a substantial and time-consuming task. This task has been carried out in previous years through a combination of large face-to-face “networking” events [2] and predominantly paper-based systems, and it was decided for 2008-9 to provide, in addition, some technological support for the process in the form of a new web-based application. This could also potentially provide easier opportunities for outside access by employers than would be afforded by something held within the VLE, Blackboard Vista.

An important participant in the commissioning of this new application has been Innovation North’s commercial offshoot, known as The Northern Technology Institute (NTI). This is an organisation that offers “accredited training programmes from industry vendors including Apple, Adobe, Zend, and Red Hat, and consultancy, as well as support for creative and technology based start ups and independent workers” [3].

2. PREVIOUS GROUP FORMATION PROCESS

Formation of groups or teams (the term group will be used in this paper) to work together may be done in many ways. In the Open University’s “Team working in distributed environments” course within its Computing degree students are randomly allocated to groups [4]. Taking another approach, Wessner and Pfister (2001) discuss the way that a degree of automated system support for group formation may be introduced into a web-based course, for the undertaking of collaborative activities [5]. In the environment of a campus-based university with the possibility of face-to-face interaction, there are additional considerations. Colbeck et al (2000) in their survey of group projects quote students as saying “We’ve been in the same classes since sophomore year ... you choose teams based on those friendship groups”. They also comment that “many students wanted to avoid grouping with ‘slackers’” [6]. Thus an element of choice in group formation would seem to be desired by students. As well as wishing to choose in regard to work ethic and possibly role within the group (all the students will be familiar with Belbin’s model [7] and others), the concept of assembling a group with a variety of areas of expertise is important. CETL ALiC states of projects that “The industrial-scale

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problems set will require the interaction of specialist teams, assembling cross-disciplinary student groups to use collectively their differing expertise to solve the problem” [8]. The Faculty of Innovation North has diversified in recent years and the Faculty now has students studying in the areas of Music Technology, Music Production, Computer Animation, Games Design or Computer Forensics as well as in the more traditional Computing and Information Systems areas.

Thus for these final-year projects, groups are allowed to be self-selecting, with an emphasis on collecting together people with an appropriate set of skills to carry out the project. For example, the project might require a database expert, a web developer, an interface design expert, a music technologist etc. In previous years, there have been one or more face-to-face “networking events”, at which students had an opportunity to hear from real-world speakers about projects they might undertake, as well as finding out about projects suggested by members of staff. They also have the opportunity to propose their own projects. They have then tried to form themselves into project groups, using non-electronic means such as post-it notes arranged on notice boards. These might advertise the skills of an individual student who was looking for a project to join, or might advertise a vacancy within a project for someone with specific skills. Notice boards remained on display after the events, as it was impossible to complete all the group formation during the face-to-face meetings. Tracking of group formation was done by entering data, when available, into spreadsheets, but it was difficult for staff to keep track efficiently of what was happening, and in particular of whether all students were committed to a group and project. Post-it notes were sometimes incomplete or illegible.

Although the VLE, Blackboard Vista, is extensively employed in relation to the projects, its group-formation facilities have not been used so far for them.

3. STAKEHOLDERS’ REQUIREMENTS

In August 2008, a decision was taken to provide additional support for final-year students in the initial stages of the group project by creating a web application to be called the Innovation Bank. This was discussed between the academic leaders of the Faculty and the NTI, and a developer (who happened to be a final-year student) was commissioned to undertake the task. The stakeholders at this stage had differing views about what would be provided by the site.

The academics wanted an application that would:

- advertise all the available projects
- facilitate the forming of groups
- record for administrative purposes the groups’ membership
- allow tracking of student progress, particularly non-engagement

The NTI, through their existing links with and awareness of local employers and businesses, were interested in promoting employability and contact between these businesses and the student body. They saw the Innovation Bank as a way of allowing employers to view the creative ideas and talent of students in an ongoing way, as the projects moved along, including links to the actual products as they were built. There has always been contact in the past between students and real-world clients, and it was hoped to extend this.

The developer hoped to provide shared online project management tools and facilities to the student groups, in addition to the group formation features. He had in the previous year made good use, with his group, of a similar web application to support their second-year group project, using it to record minutes of meetings and project milestones, and to act as a document repository. Thus he hoped to provide a similar kind of support to all his fellow students in their final year.

4. THE INNOVATION BANK

The developer created in the short space of less than one month a prototype web application (see Figure 1 for its Home Page) with the basic functionality to:

- allow students, staff and (eventually) outside individuals to register for access
- show a list of project ideas, contributed by staff, students, or outside employers (the Ideas Directory, see Figure 2)
- allow students to connect to projects on which they wished to work
- provide facilities for students to create profiles and to use blogs and forums
- deliver reports about student activity

The developer uploaded an initial list of project ideas suggested by academic staff and external employers.

A part of the site called the People Bank allowed groups to advertise for new members with specific skills and students looking for a project to advertise themselves. Project management features were not directly provided, though the groups could use forums or blogs for this purpose.

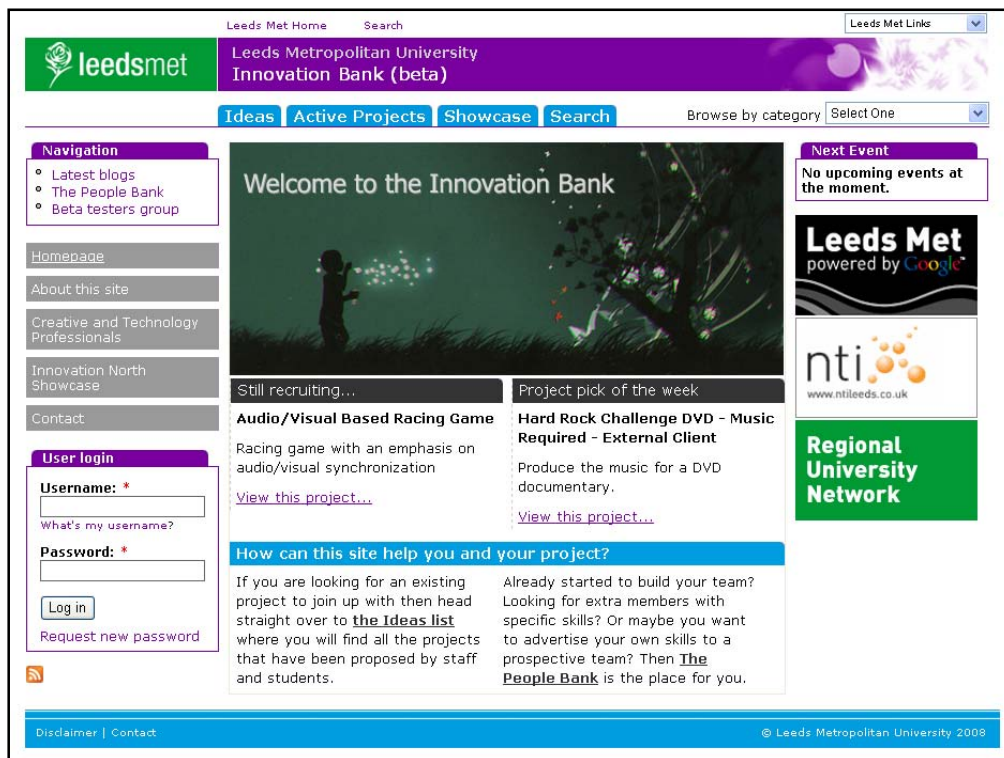


Figure 1: Home Page of Innovation Bank

| Ideas Active Projects Showcase Search | | | | | Browse by category | Select One |
|---|----------|---------|--|--------------------|--------------------|------------|
| Ideas directory | | | | | | |
| <div> 1 2 3 4 5 6 7 next > last » </div> | | | | | | |
| Project ▲ | Proposer | Members | Description | Join | | |
| "Tip of the Iceberg" (working title) | | 2 | Sound Design for Student Film | Closed | | |
| 1 000 000 pounds to raise for charity | | 11 | To Raise \$1M for a charity using a viral site.. think of it like.. www.milliondollarhomepage.com but for charity, using photos of people! | Request membership | | |
| 2d & 3d comedy trailer & website | | 4 | A short funny animation with a promotional website | Request membership | | |
| 2D Sprite-based Flash movie series | | 2 | A series of short episodes that combine to make a Flash series | Request membership | | |

Figure 2: Ideas Directory

The prototype Innovation Bank web site was developed using the Drupal framework [9], an open-source Content Management System based on PHP and MySQL. The Innovation Bank code was installed on a commercial Apache Unix server, externally hosted. The Drupal core system was expanded considerably by adding several contributed modules, most notably the Organic Groups (OG) module [10] which provided the backbone for the specific project areas' functionality. Several other Organic Groups related modules were used, including OG Contact (this provided contact forms for every project), and OG Forums (this provided the private forum areas within each project).

5. USAGE

The Innovation Bank was not solely relied upon for group formation, as this was considered to be a pilot run. Large face-to-face events were still held, and the paper-based system was still used in parallel, but students were encouraged to sign up for access to the new site. Over 60% of students made some use of the site, and 284 projects out of a total of 468 available had at least one student connected to them. The facility of being able to keep track of student progress was used by academic staff, and students who failed to engage were

identified using reporting facilities provided. However, students could form their project groups outside the Innovation Bank environment.

The blogging and forum facilities were not greatly used, and generally the students did not use the site for managing their projects as had been anticipated by the site developer.

Some problems with the new processes became evident: there were many projects presented in an uncategorised list and although some search facilities were provided this list appeared overwhelming at first view. Also, ideas for projects suggested by students had to go through an approval process before being published, and this tended to be rather slow which caused a frustrating delay in getting projects launched. The facilities to allow easy employer engagement were not fully developed in the pilot version.

6. FEEDBACK

6.1 Focus Group

In January 2009 a “focus group” meeting was held, in which employers came together to give feedback on the Innovation Bank project. An introductory talk explained its background and a discussion ensued ranging over many areas. The different uses and focuses of the project were discussed as the employers commented on what their particular interest was. They seemed to see the Innovation Bank as a (potential) publicity or marketing tool for students, with CV information integrated into the projects that were being undertaken.

More general feedback included the comments that ease of use was vital, functionality was more important than the look of the interface, that there were perhaps too many built-in tools rather than an ability to use others of the user's choice, and that there should be facilities to track projects and people using RSS feeds and the ability to “follow”.

6.2 Staff

The course leader for the final-year projects commented that, unfortunately, the group formation process was not made more convenient administratively as “many students remained connected to more than one project”, so groups could not be identified from the Innovation Bank directly. However, he felt that it “has achieved success in simplifying the presentation of hundreds of project ideas to hundreds of students” and that “it was very successful in aiding generation of many teams (by allowing students to link to ideas)”. He also expressed the view that “perhaps we should not insist that students with their own ideas should use the website”, accepting that the Innovation Bank should become one part of the project support process alongside paper-based procedures and face-to-face events.

6.3 Other Feedback

The developer reported that students made little use of blogs and forums. The functionality for supporting project management was not as well developed as had been planned, so students did not use the site for supporting their developing projects, and in particular did not show links to their product as it was created.

Feedback from students was collected informally, in the form of communication to the developer either directly or through the Innovation Bank forums. It consisted of a small number of error reports, and some suggestions for improved functionality, such as the following:

“Would it be possible to add secured, group/project access to CMS or other versioning systems to the site?”

“a personalised home page ... would be nice because as soon as you log in you can get a quick overview of everything”

“it would be cool if could put a profile up on here listing what course your on, what your major is and what skills you have”

With regard to employers' use of the site, the Director of the NTI commented that “we still had a great deal of employer involvement as before but we were reluctant to move them in to the web site straight away – in effect they were already on board with the project and we went for trying to get the students on board first of all.” Also the “problem was that the initial version just wasn't suitable for external involvement”. Her feeling was that a subsequent version would be something that would be usable for both students and employers, but that the pilot had proved useful in helping to “raise issues – such as staff responsiveness, external expectations, etc.”

7. PLANS FOR FUTURE ENHANCEMENTS

The enhancement of the site forms a student project for the developer, himself a final-year student at Leeds Metropolitan, and there are plans to use the enhanced site [11] to support the projects again next year. Issues that are being addressed, in response to feedback, include improvement of the interface, its look and feel and its ease of navigation; structuring of the list of projects into categories so that students are not presented with a huge number at once; and provision of links to third-party software tools, rather than seeking to provide all functionality in a prescribed way inside the site. This last would allow users to choose their own tools, for example LinkedIn [12] for CVs, Google Docs [13] for document sharing, and their own choice of project management software. The Profile would be extended and would allow for external links.

One suggestion by the developer is that projects could be placed on to the Innovation Bank site before term starts in September and students could be allowed access prior to the beginning of term. This would allow projects suggested by employers to be researched by students in advance. He has also suggested ways of speeding up the approval process for student projects by sending email alerts to the approvers rather than requiring them to log in to the site to check for new student project suggestions.

Improvement of the interface would enhance usability for employers; employer suggestions for tracking students and their projects are still under consideration.

8. CONCLUSIONS

Project group formation for more than 700 final-year students is a complex task that has been found to be difficult and time-consuming in the past. Electronic support for this task provided this year has achieved some success in generating connections between students and projects, but has not ultimately achieved full administrative support for group formation. The pilot run this year has not met the additional aims of providing project management support for students and a lively and continuing involvement channel for employers, but useful experience has been gained. The Innovation Bank web application is being enhanced and next year will again be used with the aim of providing multiple support functions.

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ASSESSMENT DESIGN TO FACILITATE GROUPWORK AND COLLABORATIVE LEARNING

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ABSTRACT

This paper is based around innovations during the development of a new module where there have been opportunities to define content and design modes of delivery, assessment and feedback. Group work and collaborative learning have been an important part of the course. With individual work there is always a group element to facilitate collaborative learning. Conversely, with group work, the assessment design ensures that individual work is adequately rewarded. This has been achieved by a method of grading the product of activities as well as the process by which it had been achieved. The emphasis throughout is that of a constructivist approach where students build on knowledge incrementally. The paper also draws on ideas behind systems thinking to validate the approach taken. Statistical Analysis of grades and other qualitative information including students responses are used to critique as well as suggest improvements for the future.

Keywords

Groupwork, Collaborative Learning, Constructivist Approach, Assessment, Feedback

1. INTRODUCTION

‘Learning from books or lectures is relatively easy at least for those with an academic bent, learning from experience is difficult for everyone’

Checkland [5] [6]

The past decade has seen universities adapting to methods of teaching and assessment suitable for large numbers of ICS students. However the *manageable* cohort sizes of recent years and the developments in subject areas taken together have provided many opportunities for pedagogic innovation. This was difficult previously, when the workload of dealing with large numbers of students itself took a large proportion of an academic's time. Current pedagogic innovation to varying degrees should and often does take advantage of developments in a variety of e-learning and Web tools available for teaching and learning.

In relation to information systems development, Avison and Fitzgerald [2] points out that ‘procedures, techniques, tools and documentation aids’ are only a part of a ‘methodology’. The overreaching ‘philosophical view’ is as much an important part of a developmental methodology. To provide such a philosophical basis, this project builds on previous work [1] based around constructivist ideas.

As Rowntree [3] points out assessment is fundamental to learning and 'if we wish to discover the truth about an educational system, we must look into its assessment procedures...'. Assessment is *one* aspect of a range of possible changes. When there are many changes we move away from 'cause and effect' relationships. It is a question of identifying the *Tipping Point*¹ when the changes make a significant difference to the outcome. Although assessment is at the heart of the changes discussed, subject content and delivery will have an impact on results observed.

2. ORGANISING SUBJECT CONTENT

Previous work [1] discussed the use of Case Studies to enhance experiential learning. Because Information and Computing Sciences must relate to practice, each application to teaching/learning should be a good candidate constructivist thinking. Students are often required to revisit a problem case study scenario many times over, iteratively improving on knowledge. Checkland [6] identifies four activities (within the context of 'soft systems') capable of sharp definition:

1. Finding out about a problem situation (including cultural/political aspects);
2. Formulating some purposeful activity models
3. Debating the situation using the models, seeking from the debate both
 - a) Changes which would improve the situation and are regarded as both desirable and feasible and
 - b) Accommodation between conflicting interests which will enable action to improve
4. Taking action in the situation to bring about improvement

Each 'purposeful activity' in turn helps the learner to understand the subject matter incrementally. Although every subject area might not consist of 'models' as in the application considered here, (an undergraduate second year module lasting twenty four weeks involving various models as the subject material) the conceptual ideas should be applicable in many learning situations. Cultural and political aspects are outside the scope of the syllabus considered in the current project and may form important issues elsewhere such as management and social science courses.

As in many learning situations, a previous paper [1] considered individual work and groupwork as distinctly separate activities. In this paper/project the distinction between these has a different emphasis. Every individual task has a group element. Also, as previously [1], groupwork has an individual component.

As illustrated in Figure 1, each student selects a case study from a list of possible case study scenarios (or one based on work experience). They do this in a group (normally three members) and no two students are permitted to use the same case study. Weekly exercises are always interpreted in the context of their selected case study. Students are encouraged to discuss one another's solution within their group.

Whereas with individual coursework students performed similar activities in relation to different case study scenarios, the focus with group work is very different. Group work gave students an opportunity to specialise in a selection of topics and communicated that specialised knowledge within their group. In other words, students perform different activities in relation to the same case study. Each group was required to seek out or construct their own case study.

Grades and feedback available for all coursework tasks and assessment was an outcome that was used to quantify what was learned. The lectures were brief only to introduce a subject or to provide feedback on exercises already completed. Each seminar/lab session started with a discussion of the week's topic followed by practice exercises. To reinforce, students completed each of these sessions by completing a weekly assignment. Students learnt by doing and were required to keep a record of all weekly assignments as well as extended tasks to build an individual portfolio of performance. The format for the portfolio was specified at the beginning but the 'final' submission was a derivative - a selection of items – not the whole portfolio.

¹ The Tipping Point by Malcolm Gladwell, Abacus (2002)

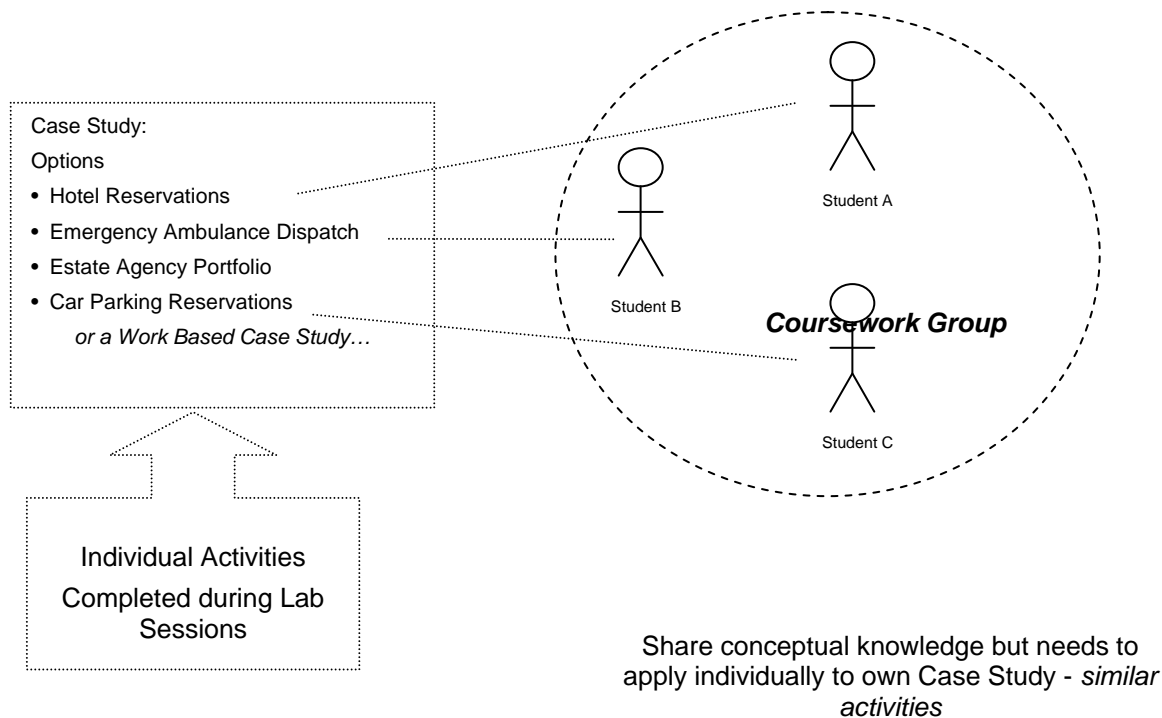


Figure 1 – Each student selects a case study from a list of possible scenarios

3. DELIVERY OF SUBJECT CONTENT

As a general rule then, as Checkland [6] points out, two questions to consider are:

- What information would support doing an activity?
- What information would be generated by it?

The answers to these questions generate the connectivity illustrated in Figure 2 (adapted from Checkland and Poulter [4])

Students throughout the course are engaged in a process of firstly, understanding a case study system and finding out its requirements. They are assisted in this process by model building followed by group discussions. A final group report is an opportunity in defining and taking action to present students' work.

3.1 Finding Out

Most students, due to lack of experience, found this aspect of dealing with a substantial case study early on in the course to be challenging. Students at the early stages covered each topic (or model) in isolation. The process of model building within the individual coursework gave students the tools that could be applied to understand the case study and structure problems solving.

3.2 Model Building

Some students had a grasp of the link between the various models after the individual coursework. As the second group coursework was on a totally different case study, it gave them an opportunity to *repeat* the finding out process of section 3.1 above, but with a different outcome – testing their understanding in an alternate domain. Because students specialised in a subject area – or particular model(s), they would have been able to get a complete picture only by discussion with others in the group.

In creating a model or a related activity students were learning individually as well as contributing to the group. Half the group coursework mark was awarded for this contribution to the group. The assessment was of the product of each student's contribution included a presentation (see 3.4) in class. The presentation gave students an opportunity to learn from each other, receive feed back and validation by an independent moderating examiner.

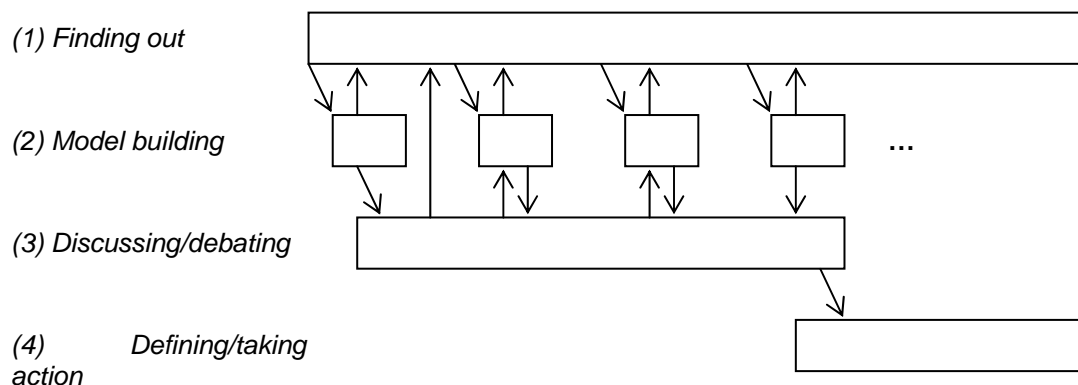


Figure 2 – Relating steps/stages to Checkland

3.3 Discussion/Debating

Discussion/debate amongst each group should have helped students to improve individually and as groups. Such collaborative learning was encouraged. Marks were apportioned for group activity as follows:

- An inception phase (10% of groupwork): a subject specific term perhaps which included establishing the scope of the solution, preliminary schedules and a task breakdown
- An elaboration phase (10%): where plans were drawn up for detailed work
- Consolidation of groupwork and quality of final report (10%) when each student was required to prepare a reflective statement outlining their contribution as well as what was learnt from the group

3.4 Defining/taking action

In a mandatory final group presentation (20%), students had an opportunity of elaborating on aspects of their work. Discussions on marks and performance were an opportunity for students to receive further feedback on their work. Observing the presentations by other's helped students to consider ideas which they may not have thought of with their own case study. This final assessment helped students to consolidate their knowledge. This exercise doubled as a revision tool for the summative examination at the end of the course.

4. ASSESSMENT

As explained in the previous sections, the assessment was *for* learning and integrated with learning throughout the course. In addition to this a progress test halfway through the course provided students with an assessment of their learning (an indicator of depth) at a crucial stage. This also provided tutors with information to set additional remedial work helping students in need of extra coaching. As one student put it 'whatever you do – don't get rid of the progress test. That is when I really woke up and started working'.

In another module previously, the best two performers at the final examination were students who failed the progress test and therefore a final analysis could only be made after the examination results in two weeks time (at the time of writing).

5. CONCLUSION

Figure 3 shows some correlation (0.65) between the groupwork and individual performance. A closer look at the results show, as would be expected, that there is a high degree of correlation between these grades for high end performers and low end performers. This suggests a marked scattering of the results for a large number of students in the middle of the range.

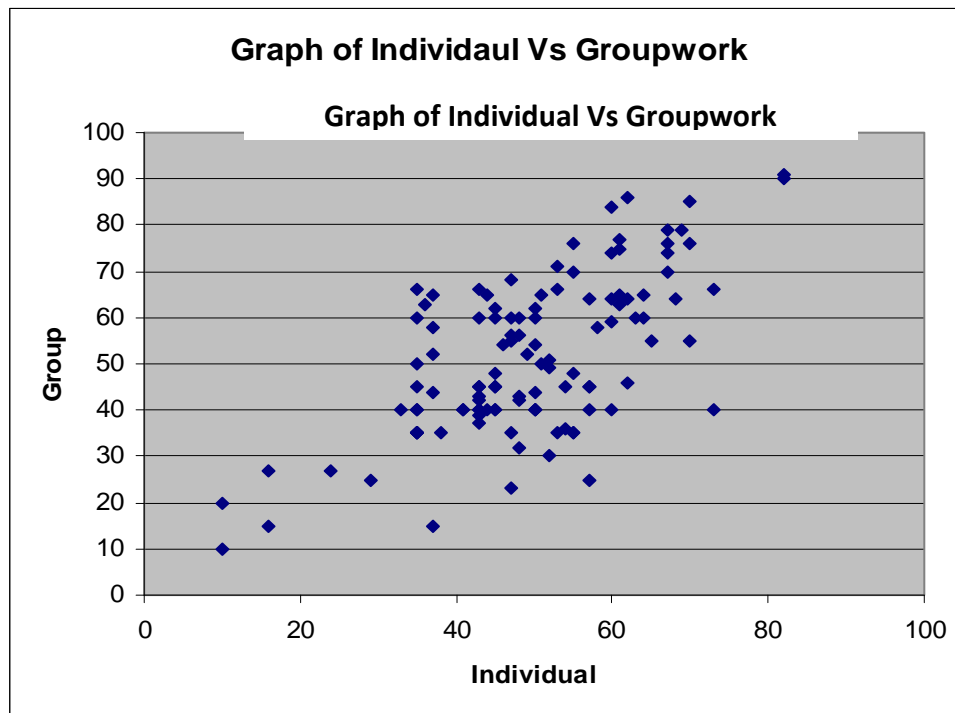


Figure 3 – Relationship between Individual and Groupwork

If the outliers (i.e. the cases which are a distance away from other data), are discarded then there will be a relatively higher correlation. However, the outliers may need further investigation. Although plagiarism is a possibility, this has not been found to be the case. The final examinations should provide valuable information about students who have done an exceptional amount of work later on in the course or those who came to a deeper understanding of the material at the consolidation stage.

Suggestions for the next year include moving the presentation/feedback from the current slot at the end of the course. This feedback from a student and refined by a colleague will be used as a basis for improvements next year. A Likert survey shows general student satisfaction with the course and the assessment regime. The use of a complex case study right at the start of the course was not without problems, and the solution is for next time in the form of simpler tasks doubling up as group forming exercises.

Acknowledgements

Thanks to Chris Sadler, who shared the teaching, helped with assessment material and over many years, has provided support and encouragement. The Likert Survey questions were provided by Noel Yahanpath of Eastern Institute of Technology, Hawke's Bay, Napier, NZ. This paper is *one* of a series of outcomes from a *CELT Writing Scholarship* from *Middlesex University*.

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THE MARRIAGE OF IT VENDOR TRAINING WITH POSTGRADUATE ATTRIBUTES: AN UNHOLY UNION

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ABSTRACT

This paper describes the collaboration between Sheffield Hallam University and an International IT Consulting organisation to develop an innovative postgraduate curriculum that combines intensive, vendor-specific certification training together with a challenging enquiry-focused educational experience. Employers prefer to 'benchmark' potential applicants against industry certification standards, yet also desire the qualities of a postgraduate's enquiring mind. Using research and 'open enquiry' as principle values, a curriculum has been created that facilitates exploration of a wide range of practical and theoretical topics in order to support the development of a highly skilled, autonomous 'Technical Consultant'. A key aspect of this approach is to provide guidance for learners to explore their own development paths, whilst also exposing them to an established vendor specific platform in order to gain sufficient practical experience before seeking employment.

Keywords

constructive alignment, critical thinking, enquiry, research-informed learning and teaching

1. INTRODUCTION

Sheffield Hallam University has offered postgraduate courses together with vendor-certified training for many years, with some industrial partnerships now entering their sixteenth year at the time of writing. In particular there has always been a significant demand for computing courses that incorporate exposure to commercial information systems such as those provided by SAP and Oracle, amongst others. Graduates from these courses have tended to find employment quickly with large companies including Accenture, Capgemini, Deloitte, Caterpillar Logistics, W.H. Smith, Rolls Royce and Siemens. During 2006 several of the large vendors released toolsets that were significantly more advanced than previously, which enabled businesses to adopt some of the marketed advantages of Service Oriented Architectures. These tools were an attempt to align IT with business better; rather than driving the business operations with the IT infrastructure, the platforms could now be developed in much more flexible ways to realise emerging business trends. Out of this development emerged a need for highly technical individuals who would be able to configure and compose business services to meet the needs of the business. These individuals would also be able to identify new business opportunities and have the expertise to rapidly react with innovative IT solutions. As a result Sheffield Hallam University decided to explore the potential to provide individuals with an experience that would support the acquisition of these skills, by utilising a long-standing relationship with an international consulting company together with an established information systems vendor.

2. BUSINESS PROCESS EXPERT

The 'Business Process eXpert' or 'BPXer' for short, is an attempt by the information systems industry to describe a role that is beginning to emerge in its own right. BPXers are primarily focused with the business, and possess the requisite skill-sets to enable existing and new IT infrastructures, together with the associated human interactions, to be modified and harmonised to enable economic advantage. Large communities such as that created by SAP (<https://www.sdn.sap.com/irj/bpx>) illustrate the interest in this particular area. Similar to many institutions, Sheffield Hallam University already taught many of the individual skills of the BPXer role, and indeed many alumni graduates were already performing such a role in industry. However, this new role description, together with an obvious demand from industry, suggested that there was an opportunity to develop a specific learning experience for potential students who aspired to work in this particular sector.

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3. CURRICULUM DESIGN

Recognising that students should develop and practice key skills during their Higher Education experience, they should understand not only the process of knowledge creation, but how that knowledge is applied to different domains. The ability to be critical, whilst understanding the legitimacy of academic integrity, will serve to create the well-rounded, articulate, autonomous learner who can subsequently engage in a life-long process of self-development. Research is often seen as an activity that supports a desire to facilitate student growth, and many institutions have integrated discipline research into their curricula. Elton [2] argues that learning and teaching environments that support the processes within learning, teaching and research create more positive links between research and teaching for learners and academic staff. Healey [4] suggests that undergraduates are likely to gain most benefit from research in terms of depth of learning and understanding when they are involved through enquiry-based learning. Curricula based upon research activity provides challenges for academic staff, since they may need to find new ways to work with students. The use of research to inform the curriculum makes explicit the systematic enquiry into the teaching and learning process itself, which has been achieved by embedding three key principles into the course curriculum. The key principles are to: integrate discipline research into the curriculum, demonstrate teaching and learning research to inform practice, and to engage students with research. Postgraduate curricula at Sheffield Hallam have traditionally allowed students to conduct enquiry in an open way and the subjects of study have typically concentrated upon the development of critical thinking skills and learner autonomy. One of the immediate challenges was presented by the 'industry view' that students should have specific, technical skills *and* the attributes of a postgraduate learner. Recognition of the technical proficiency was with reference to the benchmark – whether or not the student had passed a proprietary vendor-specific certification examination. The approach to vendor-specific training and assessment methods is clearly at odds with the remit of a postgraduate learning experience and there appeared to be little room in a curriculum to support the attainment of these two ideals. In prior years, Sheffield Hallam had offered students an MSc programme, together with an additional training academy, provided by the relevant information systems provider. Whilst in some cases this had been an unmitigated success for students, who rapidly became employable after successfully completing both aspects of the course, many students could not cope and found the extra burden of vendor training on top of an MSc just too excessive. Stevenson[6] describes how materials for a proprietary Enterprise Resource Planning (ERP) system were included at module-level, though this did not attempt to prepare students for the breadth of role that a BPXer demands.

3.1 Programme Outcomes

Discussions with three consulting companies revealed that they were all too aware of the danger of placing too much emphasis upon vendor-specific training methods and the unhealthy pre-occupation with proprietary certification examinations. However they were also unanimous in declaring that the certification test was a way of deciding which potential candidates to interview; they felt that passing the test was one indication that the candidate would demonstrate some useful attributes. With this in mind, the learning outcomes for the programme were explored in an attempt to understand the perceived need from the IT consulting industry. With reference to Biggs' constructive alignment [1], the attributes of the BPXer role were investigated with a view to developing a curriculum that facilitated the exploration of the learners themselves, whilst also gaining valuable skills with proprietary tool-sets. Utilising a long-standing relationship with an international IT consulting organisation, the following traits of a BPXer were identified as; an ability to understand the business impact of innovative IT solutions; a broad technical ability to architect and configure IT systems; 'organisational awareness' – an appreciation of managing change and culture; be an expert facilitator – educating and providing encouragement to support the proposed innovation. Whilst there were existing modules that could provide a learning experience to support the acquisition of these attributes, the onus of constructing the links between the MSc curriculum and the vendor-supplied training academy laid firmly with the student. Since the training academy is delivered over two weeks, there was little opportunity for the students to gain any practical, useful experience of the system.

3.2 The Approach

To create the balance of skills necessary it was decided to incorporate direct experience of using the information systems platform throughout the course. However it was not feasible to incorporate this into every module since these are often taught to multiple cohorts concurrently, the students of which are enrolled on courses with different specialisations. One module from each semester, Enterprise Architectures and Enterprise Systems, was chosen to modify to include learning based directly upon the information systems platform (see Table 1 for a complete list). Using an open enquiry approach, the exercises were mostly based upon students building solutions or resolving problems. After students had received basic instruction for accessing the platform in the first session, no more training was delivered and students were guided to manuals and support information for further reference. Out of the remaining modules, a further set were

identified that could usefully contribute towards the students' experiences of a proprietary platform, as described in Table 1 below.

| Module | CATS | Content |
|--|------|---|
| Study Skills for Professionals | 15 | An advanced programme of professional development. |
| Web Application Design and Modelling | 15 | Fundamentals of software engineering for portal-based information systems. |
| Enterprise Architectures | 15 | Models for large-scale information architectures are produced and formally tested. |
| Business Processes | 15 | Modelling, design, re-engineering and optimisation of business processes for information systems. |
| Change Management & Systems Implementation | 15 | Understanding the human factors of change management. |
| Business Intelligence, Communication and Behaviour | 15 | Using theoretical models for knowledge management, prototype tools are built to enhance the opportunities for businesses to work collaboratively. |
| Enterprise Systems | 15 | Models for service orientation are explored using an information systems platform. |
| Consultancy Theory and Practice | 15 | High-level consulting skills such as negotiation and selling are explored in practice by critiquing established consultancy theories. |
| Research Principles and Practice | 15 | Research methods prepare the students for the dissertation stage. |
| Dissertation | 45 | An extended professional research project |

Table 1. Course Outline.

3.3 Facilitating Learning

There is no doubt that students are attracted to the MSc as they envisage receiving a considerable amount of training for a proprietary product. We have directly addressed this potential challenge by spending a significant amount of time assisting students to explore their own abilities. Using the Skills Framework for the Information Age (SFIA, <http://www.sfia.org.uk/>)[5] the students are required to self-assess in relation to the skills required from a BPXer. This assessment is then used as the basis of a personal action plan that the student maintains in an e-portfolio, to guide their own learning. To support this, there is an alignment between the assessments and this personal development activity. Table 2 illustrates the assessment grid for one module that supports the students in their development by exposing them to Enquiry Based Learning (EBL) by way of them designing an educational curriculum for a BPXer Consultant.

4. DISCUSSION

The original aim of this programme was to develop a curriculum that incorporated education with training; under advice from potential employers there was a specific need to produce Postgraduate students with vendor-approved certification qualifications. By taking a more holistic approach, there was an opportunity to include the student within a community of research in order that they might deliver the autonomy demanded by a consulting profession. The learning experiences required to support this transformation are varied, and many of them are particular to an individual student's experience. Realising that the students would progress further if they understood better the processes of knowledge creation has meant that the existing curriculum has required modification, to facilitate a teaching approach that "draws consciously on systematic inquiry into the teaching and learning process itself." [3]

The emphasis of the MSc curriculum is now based upon the development of enquiry skills through engaging with research activity. Experience with the information systems platform is thus widened as students can engage with the tools and technologies as they conduct both guided (by academic staff), and open enquiry (self-guided with the aid of their personal action plans). Whilst the two week training academy is still provided, this is viewed more as preparation for the vendor's certification exam, rather than learning how to use the

system itself. This learning has already taken place much earlier, for a longer period of time and in a variety of contexts.

| Intended Learning Outcome | How will I be assessed ? | |
|---|--|---|
| Apply a professional development framework to assess the specific skills and knowledge required by an Business Process Expert (BPXer) Consultant (<i>group</i>) | The key word here is to apply ; can you demonstrate that you have used a professional development framework to identify the key skills required? You will need to demonstrate that you understand what a BPXer Consultant does and what the IT industry needs - this will require other 'knowledge' apart from specific technical skills; have you illustrated what this knowledge is and given examples ? | |
| Construct a 12 week educational curriculum that demonstrates Enquiry Based Learning (<i>group</i>) | Can you demonstrate that you can apply EBL to an educational programme? Can you allocate resources to a schedule so that the learner will develop appropriately ? Have you stated explicitly what the learner will achieve ? How will you assess what the individual has learned ? | |
| Apply your knowledge of the role of a BPXer Consultant and present evidence in the form of a poster (<i>group</i>) | Can you present your work in a concise way using one A1 poster ? Have you demonstrated how the group has been managed and what it has achieved ? | |
| Articulate orally a justification that will sell the curriculum to a client in the IT industry (<i>group</i>) | Can you 'sell' your educational programme to the IT industry? Have you considered the questions that they will ask of you ? What are the pressures that an IT organisation will face when considering your sales pitch ? Can you demonstrate that you have considered their educational requirements? | |
| Apply your learning to provide constructive, written feedback to other presenters (<i>group</i>) | Can you demonstrate that you understand how to assess other poster presentations and provide peers with constructive, written feedback ? What do your peers need to know to improve their work? How can you demonstrate that you can help them improve their learning ? | |
| Apply a professional development framework to demonstrate a self-assessment of your current skills and knowledge (<i>Individual</i>) | Have you thought about your own skills and knowledge and presented this in a concise way? Can you articulate orally what you have learned and evidence this with a video clip ? Can you demonstrate that you are 'self-aware'? | |
| Review your own skills and present evidence of a personal development plan (<i>Individual</i>) | Can you create a plan that demonstrates how you will develop aspects of your learning to achieve greater expertise ? Are your developmental objectives reasonable and achievable ? Are they SMARTER ? | |
| General learning outcome | You have presented your evidence in a logical , structured way. It is easy to find the evidence that supports your statements . Your writing is factual and professional and relates to what is expected of the industry. You have presented yourself in a professional manner, in the way that you have dressed and conducted yourself . You have ensured that you have only included evidence if it supports your argument and there is no 'waffle'. You have practised academic integrity and honesty . | |
| Fail | Pass | Distinction |
| Less than Pass, plagiarism evident, work not submitted or lack of evidence of professional behaviour. | All of the Learning Outcomes are satisfied comprehensively. | All of the Learning Outcomes have been met in a way that demonstrates a deep level of understanding of both theory and application, together with creativity. |

Table 2. Assessment criteria supporting an enquiry-based approach to learning.

4.1 Practical Issues for Concern

Reflecting back over three cohorts there are some practical issues to consider. Firstly the facilitation of enquiry through research activity both in and out of the classroom means that student are exposed to real-life problems such as software bugs and system administration. The situations presented by modern, complex information systems are rich with learning opportunities, providing that a solution or work around can be found. This scenario is also a rich learning environment for academic staff, who either see this as an opportunity or an encumbrance. Secondly, delivery of such a curriculum has required extensive (and expensive) vendor training to ensure that the systems run relatively smoothly. Thirdly, and most significantly, has been the influence upon the scheduling of resources. Established ways of scheduling teaching have been

mostly based upon a level allocation of resources through the year, until the dissertation where only project supervision time is required. The adoption of an enquiry-focused curriculum has highlighted a need to conduct much more face-to-face teaching at the start of the course, to prepare the students before they are 'weaned-off' to conduct their own enquiry. At present we have three stages: Semester One, with the most contact time, followed by Semester Two, with less allocation. Upon completion of the two semesters the official taught phase is completed and students embark upon their own dissertations during the third stage.

5. LISTENING TO THE LEARNERS

During the last taught module, students are asked to complete an anonymous opinion survey delivered via the University's VLE. A total of 26 respondents from 3 cohorts have taken the survey, with some of the responses shown in Table 3.

| Statement | Response |
|---|-----------------------------|
| I feel confident that I could identify wasteful business processes and implement a solution | 88% Agree or Strongly Agree |
| I feel that I have some useful practical experience of [the information system platform] | 92% Agree or Strongly Agree |
| I feel much more able to evaluate and select the most appropriate software system | 80% Agree or Strongly Agree |
| I am confident that I could argue a business case for a change to an existing system | 73% Agree or Strongly Agree |
| I feel able to teach [the information system platform] to inexperienced staff | 69% Agree or Strongly Agree |
| I feel more able to take charge of my own learning | 80% Agree or Strongly Agree |

Table 3. Student feedback from three cohorts.

The students have demonstrated a substantial engagement with the whole course, particularly when exercising their abilities to critically evaluate course content. However rather than complaining they have produced materials to supplement their own learning, whilst also making this available to their peers for their benefit also. Academic staff, as co-learners also found the course enjoyable, if challenging. The introduction of a proprietary information systems platform presented an opportunity to apply theory to critically evaluate the software, whilst also gaining valuable practical experience. As a result two members of staff successfully attempted the vendor certification examination.

6. CONCLUSIONS

The experience of developing and delivering this course has shown that there is much to be gained from using open enquiry as a focus for making postgraduate study relevant to the IT industry. Embedding the processes of research into the curriculum is one aspect of using research to inform the learning and teaching approach; satisfying the demands of the employers, in this case has also required a substantial financial investment in staff development in order to deliver the vendor-specific context.

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IMPROVING STUDENT FEEDBACK USING TECHNOLOGY

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ABSTRACT

Assessment and feedback is one of the main areas of dissatisfaction in the UK National Student Survey (NSS). The results from 2007/08 for Computer Science at Queen's University Belfast (CSQUB) highlight an average of 4.3 over the five assessment and feedback questions. All questions are similar to the sector benchmark and as a result this study will consider the assessment, but more specifically feedback methods used on a taught postgraduate course within CSQUB with the aim of providing more effective feedback to students.

Keywords

Formative Assessment, Audio Feedback, Video Feedback, Student learning, Student Retention, Part-time Study

1. INTRODUCTION

1.1 The Importance of Feedback

Student support and feedback is a problematic area within higher education, as identified by the NSS [1]. Furthermore today's students are growing up in a digital age and the use of technology to provide additional support and feedback needs to be considered, especially as traditional written forms of feedback are very passive and lose the supportive mechanisms of face-to-face communication [4]. This study will look at providing audio/video feedback to students on formative assessment with the aim of making it more intuitive and interactive given the students' experiences and knowledge of the subject area. These recommendations have been proven to have a very beneficial effect on student learning in that they encourage deep learning [2].

Formative assessment, or assessment for learning, should be used to promote learning and goal setting, to enable students to understand their own learning and as a method of feedback to show students what they need to do in order to improve their learning throughout a module. However, providing detail within feedback in a timely nature is not always necessary to ensure that students find it effective, encouraging or motivational [3][4][5]. The more pertinent issue is that feedback should help students clarify things they do not understand, within an acceptable time, if the feedback provided by tutors does not clarify or enhance learning then there is no point in returning it. In essence, feedback cannot be separated from the learning process; it is an integral element [4].

1.2 The Cohort

Feedback will be considered on a masters programme taught in CSQUB. The programme consists of four taught modules and a dissertation; each of the modules is taught in the evening, one night per week for 12 weeks. Therefore part-time students take one module per semester over two years and will only be on campus one night per week. Full-time students will take two modules per semester over one year and be on campus at least two nights per week. Only two of these modules will be considered throughout this study; both are second semester modules and have approximately 25 students enrolled. The students can be described as male and female, range from 22 to 50+ years of age, are from different social, cultural, religious and educational backgrounds and most will have had no prior experience of computing. The first module is entitled "Multimedia Programming (MP)" and the second "Using the Web for Instructional Technology (UWIT)".

The assessment for the MP module consists of a set of six individual weekly or fortnightly tasks, a group task and an individual main assignment, (worth 20%, 10% and 70% respectively). For the UWIT module the

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assessment consists of a set of four individual weekly (set every three weeks) and an individual main assignment (worth 20% and 80% respectively). The focus of this study is with the formative assessment and in particular the tasks as this has a significant impact on both the following piece of formative assessment and main assignment for each module.

The previous methods of returning feedback will be described along with the new methods introduced over the past two years. Results from the NSS along with analysis of the questionnaires completed by the last two cohorts of students will be evaluated to determine if the students find the new methods more supportive, detailed and effective than previous formats of feedback received. Furthermore, the effect on staff time, in creating the feedback, will also be analysed to determine if this could be a long term and viable solution.

2. RESULTS AND FEEDBACK FORMAT

2.1 National Student Survey Results

The NSS forms part of the revised quality assurance framework for higher education. The aim of the survey is to gather feedback on the quality of students' courses in order to contribute to public accountability as well as to help inform the choices of future applicants to higher education and was first implemented in 2005. The NSS results for CSQUB for the past two years, on assessment and feedback only, can be seen in Table 1.

| | 2007 (out of 5) | 2008 (out of 5) |
|---|-----------------|-----------------|
| The criteria used in marking have been made clear in advance | 3.3 | 3.7 (3.6) |
| Assessment arrangements and marking have been fair | 3.5 | 3.7 (3.8) |
| Feedback on my work has been prompt | 3.4 | 3.4 (2.6) |
| I have received detailed comments on my work | 3.0 | 3.3 (2.7) |
| Feedback on my work has helped me clarify things I did not understand | 2.8 | 3.1 (2.7) |
| Overall Average | 3.2 | 3.4 |

Table 1: Results from the NSS 2007 and 2008

These results while not shockingly low could be vastly improved, although it is interesting that there has been an increase from 2007 to 2008. The figures in brackets accompanying the 2008 results illustrate the subject benchmarks and as can be seen CSQUB are inline with these (only being outperformed in one area). However CSQUB envisage being higher than the average and are interested in one particular key area identified within these questions; feedback must help students to clarify their understanding.

2.2 Feedback received during the modules

Students receive many different forms of feedback throughout the 12 weeks of teaching on both modules. The most obvious is the feedback on the individual tasks, which before beginning work on this study was returned in written format (recorded in an electronic text file and saved to the student's space on a departmental server for them to collect). This feedback was returned within one to two weeks of submission therefore the issue of returning timely feedback is not a great concern. However the intention is that the prompt return of feedback will continue and maybe even improve. Other forms of feedback include verbal communication during practical sessions, tutors stepping through solutions and commonly made mistakes in the lectures, e-mail communication when students request help and sample solutions that are saved online for students to access in their own time.

Both modules are second semester modules and therefore students have already had experience of the course team and their teaching and assessment strategies. During focus group and individual meetings the tutors asked students to discuss the positive and negative impact that feedback from the other course modules, had had on them so far. They stated that feedback on one of the modules had been returned in a timely manner which allowed them to reflect on tasks already submitted. However the other module failed to return feedback on formative assessment until the end of the module. The students felt this was completely unsatisfactory and contradicts Biggs ideal of timely feedback [6]. Both tutors informed them, that, in previous years, feedback had been returned within one to two weeks on both second semester modules and they agreed that while this was acceptable it would be more beneficial if it could be returned within a couple of days given the nature of the tasks. The main concern for the students was that the feedback returned within previous modules was far too negative and actually inhibited learning. During the individual meetings with students some mentioned they had considered leaving the course due to the lack of support and positivity within feedback. This illustrates the impact tutors can have on students (especially those who are part-time

postgraduate) and as Lizzio and Wilson state negative feedback and support can have adverse effects on student self-esteem and motivation [7].

Students also admitted they only skim read the written feedback for the tasks as they found it difficult to interpret, given their limited experience of programming and web development. This was also evident to the tutors as the tasks progressed the students seemed to struggle to complete the subsequent tasks and main assignment even though they had been provided with more than adequate formative feedback. The students said they were only interested in the grade received to ensure the submission passed and most agreed that the most effective solution to this problem would be individual face-to-face meetings with the tutor to work through solutions to the individual problems, [4]. However, this is the least effective method for the tutor because it would take too much staff time and would be difficult to organise for the part-time students who are only on campus for three to four hours a week. Therefore, finding a method to provide this level of support whereby students can work through the problems in their own time would be beneficial for the tutors and the students.

2.3 Audio Feedback

Two years ago the format of the feedback for tasks was changed on the MP module only. The course team decided that changing too many forms of feedback in one year over too many modules could prove detrimental for the student. Therefore in 2007-08 the tasks' feedback was returned to students by e-mail as an attached audio file. The audio file was created using free software called Audacity and was recorded as the tutor was marking the program and associated documentation. This type of feedback was chosen as it has been proven that it provides a less intimidating and more supportive mode of feedback than written feedback [8]. Initially the students were dubious of this change however through discussion with them after two pieces of feedback had been returned (week 4); they said they felt more confident in their abilities. They stated this was mainly to do with the intonation of the tutors' voice which made it easier to interpret the feedback and it felt less negative than the written word. The other students agreed saying that they had not considered this but the negative comments were much easier to process and they did not feel as incapable of progressing in the module. At the end of this year one student admitted they had yet to listen to an audio file stating that they only realised in the last class what was contained in it (i.e. personalised feedback on each task). From this the tutor decided that at the start of next year's teaching, students should be made fully aware of the type and format of feedback received in the modules.

Students completed a questionnaire specifically on feedback at the end of the 12 week semester; the results can be seen in Table 2. It was interesting to see that the majority of students believed that between one and two weeks was appropriate for feedback to be returned, even though they had initially requested this period to be shorter than a week. In general the tutor was encouraged by the feedback, especially in comparison to the NSS results. It appears the audio feedback was found to be helpful in understanding mistakes within the tasks (average of 4.4 – Agree to Strongly Agree) and that it helped the students to correct mistakes (average of 4.3 – Agree to Strongly Agree). The students also disagreed that the grade was the only important element within feedback (average of 2.1 - Disagree). When marking was completed for this cohort of students it was believed that, in general, they seemed much more confident than in previous years when completing the main assignment and used more complex programming constructs. Furthermore the average mark had increased from 59% (of the nine students who submitted work in 2006-2007) to 63% (of the 20 students who submitted work in 2007-08) and while there will have been a number of factors to contribute to this the evidence suggests that the feedback has had a positive impact. Given the success of the feedback the tutor of the UWIT module decided to integrate it in 2008-09.

2.4 Video Feedback

Focus group meetings were arranged with the next cohort of students on the MP and UWIT modules to discuss feedback and show how the audio feedback had been used in the previous year. It was decided that there was something missing from the audio files. As the two modules were both practical-based (one in programming, the other web development) there was a visual element necessary that the audio files did not have in comparison to face-to-face meetings. It was decided to incorporate video feedback in that the tutors screen would be captured to illustrate to the students how to overcome developmental issues. The video file was created using free software called Jing and was again recorded as the tutor was marking the program and associated documentation.

The use of video for feedback was introduced differently on both modules. On the MP module video tutorials were made available after the submission of each task which explained how the solution to the problem could have been implemented i.e. a general tutorial video for the class. For some tasks only one video file was necessary but for others up to four video files were made available on the shared document resource for students to see the different ways in which the tasks could be approached. Students only received targeted

individual video feedback for this module when their submissions contained errors which could be more easily explained using visual representation rather than auditory alone. Most students still received an audio file of the feedback, sent via e-mail. At this stage the tutors also believed the videos should be better than face-to-face meetings as the videos could be replayed as often as students needed to watch them. On the UWIT module if students e-mailed for assistance on tasks the tutor sent a video file as a reply to help solve the problem. Only on the final two tasks did all students receive individual video feedback on their submissions.

The teaching for both of these modules has just finished and from speaking to students informally within the class the audio and video feedback seems to have been a success for most students and have, in general, achieved the aim of making feedback more intuitive given the students' experiences and knowledge of the subject area and to encourage deeper learning [5]. Students said that the feedback has been more supportive than that received in the first semester modules and they are more able to follow the feedback through to help solve the problems and understand the purpose behind the tasks more clearly. Also 69% of the students admitted listening to and watching the feedback more than once. The only problem to be overcome by the MP tutor is that the video files saved to the shared document resource are not seen as feedback (only 62% of students answered these questions on the questionnaire in 2008/09). Therefore at the start of next year's module there will be an interactive session on feedback in the first class.

2.5 Tutor Demands

The introduction of the audio feedback in 2007/08 for the MP module was not technically difficult. Audacity is a free open source program which when downloaded only requires a microphone to be plugged into the computer, then with the software open press the record button and talk through the feedback. Once completed for that student, press stop and then save it as MP3 (which is an option within Audacity). The difficulty or more time consuming process was in writing specific criteria for each task to ensure that the feedback was consistent for each student.

This issue was the same for the video feedback in that the tutor needed to be sure of the criteria however the video file was as easy to record using JING. Jing is a free open source program which captures what is happening on the computer screen by pressing a button within Jing's menu (to record audio alongside it a microphone will need to be plugged into the computer). The only restriction is that the software only allows a video of five minutes in length to be recorded. Once the feedback for that student is complete the tutor presses stop and saves it as a shockwave file (SWF) (which is an option within Jing). This file can be uploaded to the Internet using Jing into a password protected folder for the student to collect. Both tutors found it much easier to create the feedback than written format and believed it to be more personal i.e. not copying and pasting from a bank of typical feedback statements.

As with most change comes times of uncertainty and both tutors found that first use of the new method/format of creating this type of feedback was time consuming. However both tutors agreed that once familiar with the software and having the criteria in front of them to know what needed to be said made creating the feedback much quicker. This could also be attributed to the synchronicity of creating audio/video rather than written feedback, (as tutors were marking they were also generating the feedback). Both tutors felt that the feedback was more specific to the actual problems as it was much easier to illustrate these within the screen capture video file to help students fix the problems. Furthermore feedback was returned within one week which will hopefully be reduced again with the next cohort of students given the familiarity of creating audio and video feedback.

2.6 The Results

In the penultimate class of both modules in 2008/09 students were asked to complete a questionnaire; the summary of the results from 27 students can be found in Table 2.

| | MP (07/08) | MP & UWIT (08/09) |
|--|---------------|----------------------|
| Feedback within the module was returned within a reasonable time | 4.8 | 4.4 |
| I found the audio feedback to be better than other formats of feedback (if applicable) | 4.1 | 4.3 |
| I found the video feedback to be better than other formats of feedback (if applicable) | | 4.0 |
| I found the audio feedback to be useful in helping me understand where I had made mistakes in my tasks (if applicable) | 4.4 | 4.4 |
| I found the video feedback to be useful in helping me understand where I had made mistakes in my tasks (if applicable) | | 4.1 |
| I found the audio feedback to be useful in helping me correct any mistakes in my tasks (if applicable) | 4.3 | 4.1 |

| | | |
|---|-----|-----|
| I found the video feedback to be useful in helping me correct any mistakes in my tasks (if applicable) | | 3.8 |
| It doesn't matter how feedback is returned I am only interested in my grade/mark | 2.1 | 1.5 |
| The format of the feedback does not matter as long as the content is appropriate and useful | 2.6 | 3.0 |
| The quality of the audio was good (if applicable) | 4.6 | 4.5 |
| The quality of the video was good (if applicable) | | 4.1 |
| The quality of the content within the audio was good (if applicable) | 4.6 | 4.4 |
| The quality of the content within the video was good (if applicable) | | 4.1 |
| I found the audio feedback to be supportive (if applicable) | 4.5 | 4.6 |
| I found the video feedback to be supportive (if applicable) | | 4.2 |
| 27 responses; 19 from female students and 8 from male students 8 listened once, 9 listened twice and 10 listened more than twice 5 didn't answer if they read text feedback, 13 read it more than once and 9 only read it once 24 people answered between 1 to 2 weeks was appropriate to return feedback, 2 in less than a week and 1 didn't answer | | |

Table 2: Results from feedback questionnaires

Some of the feedback scores in 2008/09 are slightly lower than 2007/08 but are still very positive and while the questions are not exactly the same as those asked in the NSS a comparison can be made against the last three; prompt feedback, detailed content and clarification of understanding. In 2008 the NSS reported 3.4 for prompt feedback in comparison to 4.4 in this study (2008/09 only); detailed content in the NSS survey received 3.3 in comparison to the quality of content within the audio and video, 4.25; finally feedback clarifying understanding in the NSS got 3.1 and in helping understand and identify mistakes in this study achieved 4.1. Therefore not only are these results higher than the reported NSS for CSQUB but they are also higher than the sector benchmarks. However it is realised that such a comparison should be accepted with caution as the questions delivered in both questionnaires differ. It is expected that this type of feedback will now be rolled out to some undergraduate modules and further analysis into its effectiveness will be assessed. Furthermore the accessibility and universal design of using such a method will also be considered.

In 2008/09 the audio and video feedback appears to have been worthwhile on both the MP and UWIT modules. The students seem to prefer audio/video as a format of returning formative feedback for this type of practical based subject and the tutors felt more able to provide more detailed and specific formative feedback on programming and web development problems. The intention for 2009/10 is that video feedback is introduced into the theory based module on the masters course to analyse if this type of visual feedback is only applicable to practical/visual based subjects.

Overall both staff and students appear to be benefiting from this type of feedback for a practical based module; staff in terms of time and students in terms of deeper learning and better understanding of the course material.

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THE EFFICACY OF TURNITIN AND GOOGLE

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ABSTRACT

Two investigations into the efficacy of non-original content detection processes are reported. The overall conclusion is, given the limitations of the study, that Google is highly effective at detecting non-original content and Turnitin less so. Where Turnitin indicates no non-originality for a document thought to be compromised then a Google search is advocated and a technique for optimising such searches is presented.

Keywords

Non-originality detection, plagiarism, academic integrity, academic misconduct

1. INTRODUCTION

Systems and processes for the detection of non-original content in student submissions have become essential for the assurance and management of academic integrity. The best-practice guidelines [1] emphasise the importance of educating students about academic integrity and designing assessments which are resistant to cheating. However the guidelines also acknowledge that policing of coursework by means of non-originality detection and subsequent investigation is a necessary evil.

Most UK HE institutions, and a large number of non-UK institutions, subscribe to the Turnitin service. Although there are a number of other non-originality detection services none of them have anything like the Turnitin market share. However Turnitin, like any other system, can only give a low-watermark measure. That is material that is not marked as non-original is not guaranteed to be original, a consideration that is often naively not understood by, many of its users. The UK Turnitin on-line documentation at the time that this paper was prepared [2] states that it has archived over 12 billion Web pages as well as other sources including: over 60 million student papers and over 10,000 newspapers, magazines and scholarly journals.

Operationally, tutors who are still suspicious of a student submission after Turnitin has failed to locate any significant non-original content will attempt to locate possible sources by means of general Web searches. This involves: identifying the parts of the student submission which appear to be the most compromised; formulating a search string from the text in that part of the submission; submitting the search string to a Web search engine; downloading the hits returned by the search engine and comparing them with the submission to attempt to locate non-original content. Although there are tools which can assist in this process [3] it remains a laborious and resource intensive process. The market leader in web search engines is Google with 65% of the market [4]. It used to claim on its home page that it indexed more than 8 billion pages, it no longer states any figure but the number is estimated to be in the order of tens of billions [5].

The intention of the initial study presented in this paper is to attempt to start to formulate answers to questions such as:

How effective is Turnitin at identifying a copy of an arbitrary web page as non-original?

How effective is Google at identifying a copy of an arbitrary web page as non-original?

If a Turnitin search returns no hits, how worthwhile is it to search Google?

The answers to these questions will inform tutors of the most effective and efficient techniques to use to detect non-original content. The consequence of which might be more effective detection and so better maintenance of academic integrity. More efficient detection would result in tutors spending less time on 'policing', leaving more time for teaching and researching.

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The second study reported in this paper addresses the operational effectiveness of the Turnitin system. During the routine processing of BIT and computing MSc dissertations at LSBU in the spring of 2009, a tutor became highly suspicious of a dissertation he was marking. At LSBU all BIT and computing undergraduate and postgraduate dissertations, and most other coursework, is subject to routine non-originality analysis. Students have the opportunity to pre-submit their work for non-originality analysis, even though the advisability of this is still uncertain [6]. The Turnitin non-originality report for the project under investigation indicated 0% non-original content, which was itself suspicious. A cursory Google search, as described above, indicated extensive non-original content. Although Turnitin is not guaranteed to locate any non-original content, the large extent of highly obvious non-original content resulted in a more in depth investigation.

During this investigation it transpired that every 'o' character in the report had been replaced with a Unicode character which had an identical glyph. A replication of this substitution within one of the author's papers which was readily available on the Web confirmed that this made Turnitin blind to that document which was otherwise fully visible. This replication was communicated to the UK administrators of the Turnitin system and the system was adapted to ensure that such substitutions were ineffective in the future¹. During the post-mortem of this incident it was reported that students believed that substitution of every n^{th} word, or substituting $x\%$ of all the words in a document would make Turnitin blind to it. Although this had been denied by Turnitin [7] there was no independent evidence of the operational efficacy of the system. Accordingly, the second part of this paper attempts to provide independent objective empirical evidence of the operational efficacy of the Turnitin system.

2. THE COMPARATIVE EFFICACY OF GOOGLE AND TURNITIN

In order to investigate the effectiveness of a non-originality detection system, existing documents have to be submitted to it. Slatterwhite and Gerin in 1999 [8] produced a corpus of 146 documents consisting of free and paid-for essays from cheat sites, pages from on-line encyclopaedias, scholarly articles available on-line and extracts from books available on-line. They submitted all of these to a variety of services, many of which are no longer available, and concluded that Turnitin (58%) and Google (52%) were the most likely to identify the non-originality. Curiously no comparable study seems to have been attempted to replicate these findings.

One problem with the Slatterwhite and Gerin study was that the corpus was consciously assembled and that may have distorted the findings. Lawrence and Giles in 2000 [9] attempted to estimate the number of Web servers by randomly generating IP addresses and then attempting to contact a web server at that address. They then downloaded about 1000 documents from the servers discovered and used this corpus to investigate the efficacy of existing search engines. Many search engines rated in that study, including the most effective Northern Light, no longer exist as public search engines.

The corpus for this preliminary study was assembled by generating random IP addresses, attempting to contact a Web server at that address and if one existed, downloading the home page and storing it. Each page was stored as both a HTML document and as a plain text document, obtained by stripping all tags from the HTML. One weakness of this approach is that only IP4, not IP6, addresses were used; however as a preliminary study this was not considered significant.

For this study over 130,000 IP addresses were generated which led to only about 210 web servers; this is a 1 in 620 chance which is lower than the original study. Upon investigation this unexpectedly low rate was caused by a fault in the system which generated addresses which were known to be impossible, e.g. 127 loopback addresses. Of the 250 web servers only about 30 of them yielded plain text which was suitable for further investigation. Over half of the servers were inactive returning 404 error pages or a statement that the domain name was reserved. A further 12% were non-English and were excluded for this reason, 20% were password protected and so not accessible and about 6% had home pages which were non-textual (that is contained some form of code which generated the page which then might consist largely of a Flash animation). This snapshot of the web is probably much different in composition from the snapshot taken by the original study in 2000.

The 30 plain text documents obtained ranged in size from less than a kilobyte to about 10 kilobytes; although one was more than a megabyte. Some of the smallest pages had to be excluded from the study as they were too small to be analysed by Turnitin. This left a corpus of 26 documents which were used to assess the efficacy of Google and Turnitin.

To test the efficacy of Turnitin the random 'six word' technique was used. This is derived from currently unpublished research by the author [10] that very strongly suggests that taking a sequence of six words

¹ The student in question is, at the time of writing this paper, subject to an academic misconduct investigation. It was decided to make no mention to the student of the attempted deception and the evidence consists of the Turnitin non-originality report from the adapted system.

randomly from a document and submitting it as an exact search string to Google is as effective as carefully selecting a string believed to be characteristic of the document. Using this technique Google located 23 of the 26 documents. Of these 23, 21 were first on the ordered list returned by Google, 1 was 4th and the remaining document was 11th. Of the 3 missed documents one was a complete miss, one was a heavily plagiarised document which existed in various forms in many locations and the six word text chosen for the last turned out to be very generic; retesting this document with another six word extract revealed another heavily plagiarised document.

The results of the analysis of the corpus of 26 documents by Turnitin are shown in Figure 1. The graph shows the percentage non-originality (NOR) for each of the 26 documents, ordered by the amount of non-originality detected. Five of the documents were reported as having no non-original content and a further 4 as having less than 20% non-originality (NOR), which operationally might exclude them from detailed scrutiny. An examination of the Turnitin reports showed that there were some 'close hits', where there was duplicated content on a web site and the duplication page, with less than 100% non-original text, was reported. Other reports showed 'mis-hits' where plagiarised or partially plagiarised pages were reported. However in some cases there were 'hits but missed' where Turnitin had identified the correct Web page and could have reported a near 100% hit, but failed to do so. Some, but not all of these 'hits but missed' might have been due to rapidly changing page content. Of the three documents which were missed by Google 1, the original heavily plagiarised document, was located by Turnitin.

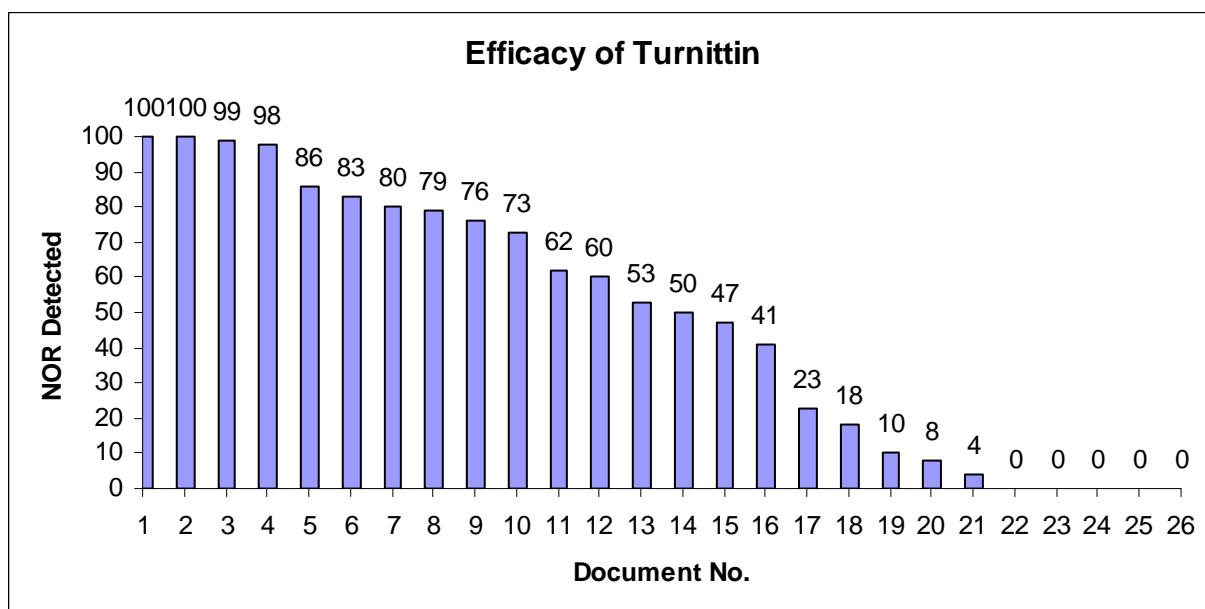


Figure 1. Efficacy of Turnitin

3. THE OPERATIONAL EFFICACY OF TURNITIN

As explained in the introduction the objective of this second investigation was to investigate the operational efficacy of Turnitin in order to confirm or dispel rumours that it was relatively easy to disguise a document by word substitution in order to make it blind to the system. In order to conduct this investigation it would be necessary to have a series of documents which had a very low, preferably 0%, non-originality score when submitted to Turnitin and variations of these documents which contained a known amount of word substitution. After some informal tests it was decided that a very simple random sentence generator would be sufficient. Three samples of the kinds of sentences generated are illustrated in Figure 2.

A blue sensible stoat thrashed the lilac crafty duck at paragliding, observed by a violet cumbersome wolf.
A green loveable duck triumphed a khaki smart duck at antiquing, arbitrated by the burgundy crafty snake.
The green loveable hamster triumphed a grey smart duck at surfing, arbitrated by the purple crafty snake.

Figure 2. Randomly generated sentences.

The first two sentences illustrate different alternative sentences generated from the same sentence template. The number of possible sentences that could be generated from this template is in excess of 2,000,000,000,000,000,000. The third sentence is a copy of the second sentence with every third word substituted. There were four such sentence generators, the outputs of which were catenated together to produce a paragraph. Ten such paragraphs were then assembled into a text document, which contained

approximately 550 words. The software that produced the documents was designed to be able to produce pairs of documents which controlled amounts and patterns of non-originality.

Two sets of pairs of documents were prepared. The first set was known as the systematic set and had every n^{th} word substituted, where n ranged from 2 to 9. The second set was known as the statistical set and had $x\%$ of the words substituted at random, where x ranged from approximately 5% to approximately 95%. One document from each pair was submitted to Turnitin for non-originality checking, with all documents reported to be 100% original. One day later the other documents from each pair were submitted and the percentage non-originality reported was noted. The results of this investigation is shown in Table 1.

| Systematic | | Statistical | | | |
|------------|--------------|-------------|--------------|-------------|---------------|
| Actual NOR | Detected NOR | Actual NOR | Detected NOR | Actual Ctd. | Detected Ctd. |
| 50% | 0% | 95% | 95% | 43% | 17% |
| 67% | 68% | 90% | 90% | 38% | 0% |
| 75% | 76% | 85% | 86% | 34% | 7% |
| 80% | 81% | 82% | 82% | 27% | 0% |
| 83% | 84% | 75% | 75% | 25% | 0% |
| 86% | 87% | 73% | 74% | 21% | 0% |
| 88% | 88% | 65% | 66% | 13% | 0% |
| 89% | 90% | 60% | 59% | 8% | 0% |
| | | 55% | 53% | 5% | 0% |
| | | 48% | 40% | | |

Table 1. Turnitin Actual cf Detected non-originality

For the systematic data the 1 in n word substitution has been converted into percentages in order to be immediately comparable with the statistical data. Hence the 1 in 3 word substitution is reported as 66% non-original. Figure 3 shows the actual non-originality on the x-axis against the detected non-originality on the y-axis, for both the systematic and statistical sets of pairs of documents. The detected non-originality for both sets remains in lock step with the actual non-originality until somewhere below the 65% range. Below this the systematic graph has a discontinuity with 0% non-originality being detected when 1 in 2 words are substituted. The statistical detection fails more gracefully but is increasingly unreliable below about 50%, dropping to 0% detected below about 40% actual.

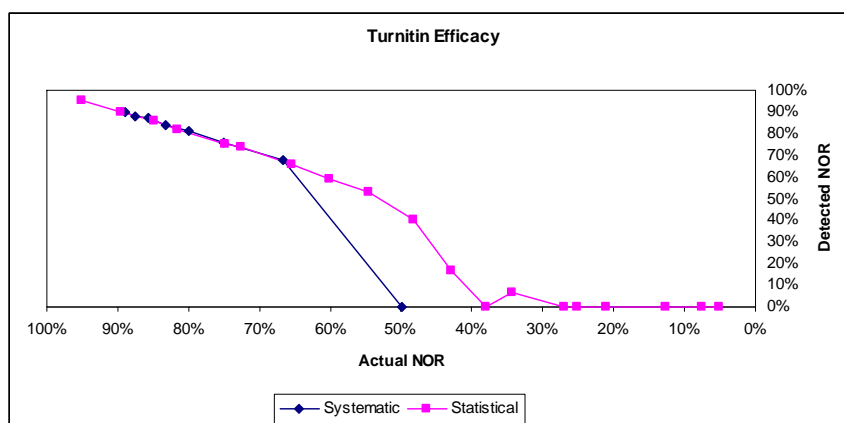


Figure 3. Turnitin Actual cf Detected non-originality

4. DISCUSSION & CONCLUSIONS

The most obvious conclusion from these studies is one that is almost intuitively obvious to tutors engaged in the management of academic integrity: when Turnitin fails to indicate non-originality in a document that is giving cause for concern then a Google search should be attempted. What is also clear from these studies is that there is no simple and obvious mechanism that can be used to make a document, which would otherwise be visible, invisible to Turnitin. Only the rigorous replacement of every second word was shown to make documents invisible, but in practice this would also make any realistically sized document unreadable.

The Slatterwhite and Gerin study was able to conclude that Turnitin and Google were 93% and 88% effective respectively. The basis for this quantitative statement is not immediately clear. From this study it would seem safe to say that Google showed itself to be 81% effective if only first hits are considered or 88% effective if all

hits are considered. The percentage efficacy of Turnitin is much less clear. If only near 100% hits are considered then it is 15% effective, if only 50%+ hits are considered then it is 54% effective. At LSBU a rule of thumb is used to look in detail only at documents whose Turnitin non-originality score is 15% or greater. On this measure Turnitin is 69% effective. What is clear, and not surprising, given the number of Web pages indexed by the two systems is that Google is more effective than Turnitin as far as the public Web is concerned.

There are some significant caveats on these studies. For the first study, the size of the corpus was very small and contained some very small documents, additionally these documents were all web site home pages. It is very reasonable to suppose that, even given the home page consideration, the random sampling of public Web pages is not representative of the sources which might be used by students preparing coursework. One mechanism which has been shown to be useful in improving the efficacy of non-originality detection tools is to focus upon the references that are included within the whole corpus [3]. A student who has used a Web resource legitimately is likely to include the URL in the list of references; a student who has used the same resource illegitimately is much less likely to have done so. Hence gleaning URLs from student submissions is likely to yield a corpus of documents which have a greater potential relevance to student submissions. If Turnitin is using this technique then the relevance of their corpus, and hence their operational efficacy, is likely to be higher.

The first study also was searching for complete documents which had not been disguised. Operationally this is rarely the case, documents which are compromised contain parts which are non-original and parts that are assumed original. There may be extracts from more than one source document contributing to the non-original content and various disguise techniques may have been attempted on the non-original material. Finally, the Turnitin corpus, and the resources used by students, include far more than public Web pages. The impact of these sources upon the overall efficacy of the system is unknowable from this study.

For the second study, the artificial nature of the documents might have some impact upon the efficacy of the system. Reassuringly, the system has been shown to be highly effective with high levels of non-originality. Where there is less than 50% non-original content the system is much less effective and seems ineffective below about 40%. However, the non-original content in these documents is distributed evenly throughout their whole extent. This is not typical of realistic documents where non-original content is usually concentrated in several places; giving much higher local rates of non-originality and so effective detection.

The answers to the three questions posed at the start of this paper might be that Google is highly effective at locating an arbitrary Web page, Turnitin is less effective but might well be effective enough and if Turnitin gives a clean bill of health to document which is causing concern an efficient mechanism for using Google has been suggested.

5. ACADEMIC INTEGRITY STATEMENT

The original work associated with the study of the comparative efficacy of Turnitin and Google was done by Stephen Pelling a 2008/9 final year Computing student at LSBU, under the direction of the author. The paper was written in its entirety by the author and has a 0% non-originality overlap with a draft of the student's report. This work is unfunded and this is the first publication reporting it.

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AUTOMATING FEEDBACK: THE CAFEX2 PROJECT

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ABSTRACT

In this paper, we describe work in progress relating to automating production of feedback on coursework. A software demonstrator, currently in development, is described that assists in rapid production and distribution of comparable and constructive feedback. We identify key considerations for feedback, and suggest that visualization-based searching, readability and sentiment analysis might be combined with comment banks to address key characteristics of feedback. In principle, such a development could improve the student experience, reduce the academic workload, and support wider considerations for standardization.

Keywords

Feedback, Sentiment, Readability, Searchability, Visualization, National Student Survey.

1. INTRODUCTION

Responses to questions in the National Student Survey (NSS) impact on the performance of both Universities and Departments in various league tables. Since applications to degree programmes are partly dependent on perceptions of performance, it is in the interests of Universities and Departments to seek to improve results wherever possible, particularly where all other factors may be strong. Suggestions for seeking improvements that can be allied to time savings are likely to be well-received, but increasing the demands on academics with limited apparent benefit is unlikely to be popular. One key area for improvement seems to be feedback and assessment. Reports of cryptic feedback (e.g. THES, 18 September 2008) suggest there is much that can be done in this direction, and feedback given to students may not be of the consistency or standard that lecturers believe [7]. For academics, providing feedback is a task that can take considerable time and may prove frustratingly repetitious. Comment banks may help in reducing repetition, but can only become properly useful when comments can be associated to marks and marking schemes so that marking (ranges) can be derived and, perhaps, so that students receiving the same comments also have some confidence that they contribute to similar marks. At present, production of limited, or the wrong kind of, feedback may be a result of the time required, repetition, required speed of delivery, and distraction due to other academic priorities.

In this paper, we discuss current research and development in the Constructive Comments, Assisted Assessment, Faster Feedback and Enhanced Experiences (CAFEx2) project towards a software prototype for automating production of feedback. We are attempting to reduce the overall time taken for providing feedback by considering efficiencies that could be introduced through a web-based software system that accounts for considerations in the literature relating to feedback and assessment [1], [3], [6], [8], [10]. In particular, we are exploring techniques from Natural Language Processing for readability analysis [12], [15] and sentiment analysis (e.g. [14]). The project is due to be completed in July, and is part-sponsored through Development Funds by the Higher Education Academy Subject Centre for Information and Computer Sciences (HEA-ICS), and through the Teaching with New Technologies (TeNT) programme from Surrey's E-Learning unit.

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2. BACKGROUND

Relevant literature covering provision of feedback makes consideration of four key factors: how prompt, how succinct, comparable generic statements, and comment structure [1], [3], [7], [8] but with differing views over what should be provided (see Table 1). There are agreements and disagreements amongst these authors, and indications that certain assumptions should be challenged. Firstly, promptness is key and should be borne in mind throughout. Next, there is largely agreement over comments being succinct in nature; it might be assumed that improving feedback means providing more of it, but care is needed here since the student might be overwhelmed by volume and discouraged by fear of extensive criticism. There is apparent disagreement [1], [3] over how helpful short generic comments, such as identifying “goodness” of specific contributions, can be. Furthermore, two models for feedback have been identified [8]: the interactive approach, in which students self-evaluate through reflection, and the feedback sandwich, in which the “filling” may comprise negative comments. It is debatable whether students, or any consumer, would eat a sandwich with a bad tasting filling, but there is some agreement [3], [8] that feedback should at least have positive beginnings and endings. To improve promptness of feedback, comment banks are recommended [1], however there is limited consideration for ensuring these are appropriately populated.

| | Prompt | Succinct | Generic | Begin & End Positively |
|--------------------|--------|----------|---------|------------------------|
| Haines [8] | Y | Y | | Y |
| Bright [3] | Y | Y | N | Y |
| Glover & Brown [7] | Y | Y | | |
| Biggs [1] | Y | | Y | |

Table 2: Perspectives in relevant literature regarding characteristics of feedback

We conducted two surveys (2008, 2009) of students regarding perceptions relating to these characteristics. Though receiving limited numbers of responses in each case, key findings are largely in keeping with the above:

- (i) knowing when feedback should be returned, and when it actually is, is generally important - it was assumed that a standard expectation was communicated sufficiently well, however tracking per assessment is recommended and relatively easily achievable;
- (ii) students prefer form-based written feedback on work, and are increasingly demanding greater detail – without automation, this will impact on speed of return;
- (iii) students are increasingly comparing marks with peers, and standardization issues may exist in variations in comments for same marks, and vice versa;
- (iv) a majority would prefer standard initial comments with detailed individual feedback.

We investigated support in software for provision and analysis of feedback comments in notable applications including Electronic Feedback 9 [5], e-CAF [16], Turnitin's Grademark and Circle of Excellence's MarkThis (now discontinued). While support for electronic provision of feedback, for example via email, is available and many of these support, or supported, re-use of comments, none currently analyze the comments, and all appear to be focused towards individual users.

Literature, survey and extant software leads us to suggest a web-based system that provides significant assistance in the rapid production and distribution of standardized, comparable and constructive comments and feedback on assessed work. This software should: (i) integrate with standard “office” software to allow both for administrative collation of feedback and distribution to students; (ii) ensure “minimal” feedback standards by providing standard/generic comments associated to specific marks, or ranges of marks, within marking schemes, and use these ranges alongside weightings to imply a range for expected overall marking; (iii) improve speed of feedback by exploiting commonalities in feedback comments for search/reuse; (iv) enable rapid production of standardized feedback using template comment structures and an adaptable and searchable comment bank, associated to the marking scheme; (v) ensure positively formulated and highly readable feedback by incorporating techniques of sentiment analysis and readability in comment validation. Such an application may help confusing students with similar comments for different marks or vice versa, and by different academics. Introspection would also be enabled in considering comments against marks; such introspection would key into standardization in quality assurance. The time taken to produce feedback may provide a measure of success for the software.

3. DEVELOPMENT ACTIVITIES

An initial dataset for analysis and system testing was obtained by transcribing a variety of printed and hand-written feedback comments for undergraduate final year projects. These projects are supervised and examined by academics across the Department, thereby providing significant potential for variability. Duplicate and near-duplicate comments were retained to allow for subsequent analysis phases including assessing marking/comment variability. This dataset has 5 sections of comments, but only an overall mark, and no per-section weightings. The HEA-ICS Comment Bank was also used as a data source for certain of our analysis. Further datasets, with variations in mark allocations and section weightings will be used subsequently.

3.1 Analysis

3.1.1 Deduplication and standardization

From comments, we identify variation by considering shared patterns of characters using the Dice coefficient common to information retrieval. We produce all contiguous 3 character substrings for each word, and suggest near-matches for standardizing, or identify that comments need to be filtered and/or marking set appropriately. Since marks are not per-comment in our project comments dataset, one short comment, “Good technical knowledge and depth of understanding of key principles and techniques to be used in project”, was part of overall marks awarded that varied from 55 to 75%. “Appropriate” was used in place of “Good” with a similar spread. This should address issues of comment/mark variability.

3.1.2 Sentiment Analysis

Sentiment analysis has been variously used for determining strengths of opinions on a variety of subjects, including those of customers towards companies and for reviews of products (e.g. [14]). Various language resources, such as SentiWordnet, are freely available for those interested in undertaking this kind of analysis. Our use involves consideration for how comments will be received, with positively formulated comments preferred. We first analyzed the HEA-ICS comment bank, containing around 100 comments comprising about 2200 words, considering a relatively simple view of sentiment. Word frequency and collocation patterns [6] were examined, and negative formulations were common: 48 instances of “not”; 9 “insufficient”; 5 “inappropriate”. Example expansions include “not well” (e.g. paragraph not well divided; [method or methodology] not well reported), “not properly” (summary not properly constructed); and “not broad” (references not broad enough). Those advocating the feedback sandwich would certainly need to wrap such comments with positive statements, though with moderate effort a number of these could be reformulated to provide constructive comments. To automatically evaluate the sentiment of such comments we have used the National Centre for Text Mining’s Sentiment Analysis web demonstrator¹. Sentence-level sentiment analysis indicates how comments might be received by students, and an example of the use of this software against the HEA-ICS comment bank is shown in Figure 1.

Figure 1: Sentiment analysis of first comment in HEA-ICS comment bank

3.1.3 Readability

Sentiment analysis indicates positive or negative comments, but not whether comments will be easily understood by the student. We are more generally considering the contribution of improved readability towards improved understanding; dealing with cryptic feedback is beyond the scope of this activity. It has been suggested that feedback comments with improved readability may improve learning outcomes [15]: this study considered those with learning difficulties, though findings may also apply to students engaging with scientific writing that has been accused by some of being variously impenetrable [9]. Readability research has tended to focus on a numeric evaluation of style of writing, following [11], with common readability measures providing a document-level indication based on sentence lengths and word lengths measured in syllables. In contrast, we consider “familiarity” and modifications that are intended/assumed to make text more readable² where, for example, “ensure” can be replaced with “make sure”, and “additional” with “extra” to improve readability. Familiar words have been shown to be more readily understood and to impact positively on comprehension [2] [4]. We are evaluating a sentence-level readability metric, comparable to common metrics, that will indicate readability of individual feedback comments based on familiarity, with further consideration for other text and cognitive factors [13]. Using our own implementation for extant metrics including FOG, Kincaid, ARI, SMOG and Flesch (see e.g. [13] for further details), we have tested the impact of the minor changes mentioned previously: for “make sure”, the number of words in a sentence would be increased, with a slight increase in FOG, no change in SMOG, slight falls in Kincaid and ARI, and an increase in Flesch (a more readable sentence should decrease all but Flesch).

¹ http://text0.mib.man.ac.uk:8080/opminpackage/opinion_analysis

² Plain English Campaign, A to Z of alternative words: <http://www.plainenglish.co.uk/alternative.pdf>

For “extra”, the correct effect occurs. To address the inconsistency, our measure uses the 100m words of the British National Corpus (BNC) of general English language as a proxy for “familiarity”. We evaluate familiarity by calculating “weirdness” [6] for each comment word in comparison to the word’s frequency in BNC, and calculating the average weirdness for the sentence. Results are summarized in Table 2. Further evaluation of this measure, as well as considerations of idea density and cognitive load, is being made - with appropriate integration of existing components from a previously completed EU research project due in the next phase.

| | FOG | Kincaid | ARI | SMOG | Flesch | <i>Familiarity</i> |
|---|------------------|------------------|------------------|------------------|------------------|--------------------|
| The student should try to report on her intermediate result to ensure that credit is achieved regardless of the final technical outcome. (... make sure ...) | 14.25 (14.42) | 13.37 (12.88) | 13.98 (13.82) | 13.95 (13.95) | 38.38 (43.72) | 516.64 (464.52) |
| We recommend the student makes use of the additional support in the department to improve his oral and written skills. (... extra ...) | 14 (12) | 11.68 (10.5) | 11.65 (10.47) | 12.49 (10.75) | 46.95 (55.41) | 441.25 (433.5) |

Table 3: Impacts on readability measures due to use of the Plain English Campaign’s A-Z of Alternative Words

3.1.4 Visualization for search

A key consideration for swift return of comments from such a system concerns search and selection, or creation, of comments. Predictive text mechanisms can help in initial keyword selection, but navigation, filtering and search reformulation become expensive over time. We have explored how the IBM ManyEyes visualization software could speed comment selection and creation. The HEA-ICS Comment Bank has been formulated as a WordTree³ showing a frequency-tuned view over left- and right-contexts of the searched word. Single-click selections within the WordTree refine the search. Unfortunately, this application does not currently allow for, amongst other things, views of both left and right contexts to inspect entire comments, multiple keyword searching, or predictive text mechanisms to avoid empty result sets. Rapid selection of comments, and templating, should be supported by a similar approach, and this is under consideration for our system.

3.2 Software Prototype


A web-based software prototype is in development. Feedback can currently be produced by searching for one or more comments, ordering and post-editing, by adding new comments, or by refining existing comments; every existing comment has marks associated and is tested for its sentiment. The software supports querying of the comment bank using keywords and/or marks (within 5 marks), and according to marking category (see Figure 2). Results of search are currently displayed in a selection list, with a view towards use of a WordTree as an alternative selection component. Users can select and merge multiple comments by ticking relevant boxes. The non-editable suggested score shows the average of the scores for each selected comment. Custom marks can be associated when the suggested mark is deemed inappropriate. On saving, feedback and mark is associated to the selected student.

4. FURTHER WORK

The CAFEx2 project is on schedule and due for completion in July 2009. To date, we have reviewed extant systems and research, surveyed our students, collected and analyzed data, and begun development of the software demonstrator which already supports production of feedback and associated marks. The next steps for our development are:

- (i) incorporate components for document creation - use of Apache POI to “mail merge” feedback suitable for administrative use and distribution;
- (ii) improve comment incorporation as a verification stage to process comments for spelling and grammar, and wider considerations of readability (*text factors*), with appropriate suggestions based on results of analysis;
- (iii) implement efficient comment storage to deconstruct comments when formed of several previous records with optional edits, and band checking to assess the combined consideration of marking ranges and weightings in producing suggested overall marks;
- (iv) incorporate visualization to cater for selection from longer sets of comments (under consideration);
- (v) test and evaluate the system for simplified production of feedback;
- (vi) demonstrate, disseminate and distribute the software.

³ <http://manyeyes.alphaworks.ibm.com/manyeyes/visualizations/hea-ics-comment-bank-word-tree>

Department of Computing


Information about...
Information for...

Student List

| URN | Forename | Surname |
|---------|-----------|----------|
| 3553078 | Qia | Ge |
| 3454033 | Lingyan | Ding |
| 3664078 | Kumar | Deepak |
| 3545051 | Smith | John |
| 3341025 | Ward | Chris |
| 3553064 | Fu | Jie |
| 3353642 | Boardman | Nick |
| 3453238 | Blackburn | Doron |
| 3783021 | Law | Steven |
| 3435078 | Javis | Nicky |
| 3553022 | Clark | Vicky |
| 3343042 | Boldman | Chris |
| 3034011 | Joy | Mac |
| 3342032 | Zhang | Lei |
| 3554371 | Good | Phillips |
| 3830265 | Wong | Athena |
| 3550384 | Kidd | Churence |
| 3482093 | Barn | Michael |

URN: 3553078 Student: Qia Ge

Section Select
Theory Knowledge Presentation Management Overall

project
Feedback search by percentage (e.g. 64)
Search

Description
Percentage
Selection

Appropriate knowledge and depth of understanding of key principles and concepts to be used in project.
60
☐

I get the impression that you are capable of doing a good final year project.
48
☐

The student showed some code which was nicely structured, however he did not show a working demo (but had shown working demo before) and discussed design issues on an appropriate level. The student has made substantial progresses in Java, he needs to improve a bit on the implementation side.
Suggest: 56 %
Custom: %
Save
Validation

Overall Sentiment: Positive
The student showed some code which was nicely structured, however he did not show a working demo (but had shown working demo before) and discussed design issues on an appropriate level. The student has made substantial progresses in Java, he needs to improve a bit on the implementation side.
Theory: The student has made a good effort at applying the theory we have taught you. It is only the use of SQL that seems rather odd. (Neither of the examiners would have used a relational database to sort out the timetabling - an associative array would fit in memory and be much faster to access)
Theory Score: 75 %
Knowledge: The student showed some code which was nicely structured, however he did not show a working demo (but had shown working demo before) and discussed design issues on an appropriate level. The student has made substantial progresses in Java, he needs to improve a bit on the implementation side.
Knowledge Score: 56 %
Presentation: Very good presentation.
Presentation Score: 60 %
Management:
Management Score:
Overall:
Overall Score:

| | Theory | Knowledge | Presentation | Management | Overall |
|---|--------|-----------|--------------|------------|---------|
| Score: | 75 % | 56 % | 0 % | 0 % | 0 % |
| Generic marking criterion for a specific band | | | | | Band |

Generate Report
Save Report

Figure 2: Initial interface for the feedback prototype.

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ENFORCING MODEL TRACEABILITY FOR EFFECTIVE LEARNING OF OBJECT-ORIENTED DESIGN

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ABSTRACT

It has been observed that students doing a 2nd module in object oriented (OO) programming find it difficult to make smooth and justifiable transitions from software functional requirements to an implementable OO design. A cause for this is that the students fail to make semantic connections between models of different types such as use cases, class diagrams and sequence diagrams in order to come up with a detailed and implementable class design. This paper suggests that understanding and maintaining model traceability across different design stages play an instrumental role to fix the problem. We introduced the idea of enforcing model traceability in our classes in the last two years. An analysis of the student works and assessment statistics suggest that it has contributed to improving student performance in both written examination and practical programming coursework in an OO programming module.

Keywords

Computer science education, Object oriented design, Object oriented programming

1. INTRODUCTION

In this paper, we present a solution to a common problem in teaching object oriented design in the context of a second module in OO programming, e.g. "Further programming" or "OO software design and development". The problem, which is recurring in our classes for every cohort, is related to our students' failure to make smooth and justifiable transitions from software functional requirements to an implementable class design. It is worth noting that the module is essentially of OO programming, rather than OO analysis & design, and students doing this module should have done a 1st module in OO programming.

The remaining part of this paper is organised as follows. In the next section a detailed description of the problem is provided. An analysis of the problem with regards to the essence of OO design is given in section 3. An approach to fix the problem based on the idea of enforcing model traceability is presented in section 4. Section 5 reports early results, and provides an evaluation of the approach. Finally, some conclusions and directions for further development are given in section 6.

2. PROBLEM DESCRIPTION

Entering our 2nd module in OO programming students are required to have completed a module in introductory OO programming in Java, in which they learned how to develop OO programs (i.e. classes), mostly at the programming language level with a *language centric perspective* [7]. This 2nd module requires more than just designing internal data structures and imperative programming inside individual methods within a class. Students are required to build an OO design for software which needs more than just one class to provide the software's required functionality. For example, students may be asked to develop a Java program *to simulate* a simple handheld arithmetic calculator, which is different from being asked to write a Java program *to perform* arithmetic operations - something they could have already done in their 1st OO programming module. The former task requires a design of classes for a calculator *simulator*, which should have a display area and a keypad to accept keystrokes from the user. The simulator should be able to work out e.g. what are the 1st operand, the operator and the 2nd operand before executing the operation, and displaying the result. Also, the user should be allowed to press the "C" key to cancel in the middle of a keystroke sequence to start a new calculation, and so on. This task is very much different from the later task, which doesn't require any kind of object design because a simple coding for an input-process-output sequence would do the job.

It was very common that the majority of our students were able to write the code to implement classes, which were provided to them by the tutor. They would usually be able to work out the internal structure of methods of a class, given the methods' signatures. In other words, students were able to do programming at the

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programming language construct level, understanding and being able to use language keywords, control flow structures i.e. sequence, decision and iteration, as well as some Java APIs (Application Programmer Interfaces). However, when it came to the class design students would usually get lost, not being able to make transitions from the software functionality to an implementable software class design in a methodical and justifiable manner. In the worst scenario of the above calculator simulator example students might write a Java program in the same way as they would do in their 1st OO programming module, i.e. without including any kind of simulation of the calculator's display and keypad, and not allowing any interaction between the user and the calculator. In a typical example of an OO development task, e.g. to develop a software for a video rental shop, it is not uncommon that students could come up with classes such as *Borrow*, *Return*, *Pay fines* alongside *Member* and *Video*.

In terms of the design techniques, it is often that our students would be able to use sub-sets of OO techniques and/or notations here and there to create various OO artefacts such as use cases, class diagrams and sequence diagrams. However they find it difficult to establish logical links between these *single-sided* models in order to come up with an implementable class design, e.g. links between a use case and classes which are established via the use case realisation, links between sequence diagrams and system events invoked by external actors, and links between classes and messages of a sequence diagram. Even worse, when it comes to the actual implementation, their software classes might *come from nowhere*, not being derived from the classes and models created from the precedent design stage.

Students performing object design in the described manner would not be able to appreciate any practical benefit from the object design activity as to how the object design could facilitate the programmer in *converting* the software requirement to the software class design. Rather, they only create design models after they have written the code merely for the sake of documentation.

3. ANALYSIS OF THE PROBLEM

The ultimate aim of any object design is to come up with an implementable *software class* design from the software required functionality. While the functionality is *what*, the software classes can be seen as *who* i.e. those to carry out the *functionality*. In OO programming, because classes are just static code it is the objects instantiated from the classes at runtime that have *behaviours* to execute the software functionality. This relationship can be seen as in Figure 1. A software development cycle begins with a *what* and should end with a *who*. To our students the *what* and *who* are easy to understand but the *how* is not always obvious.

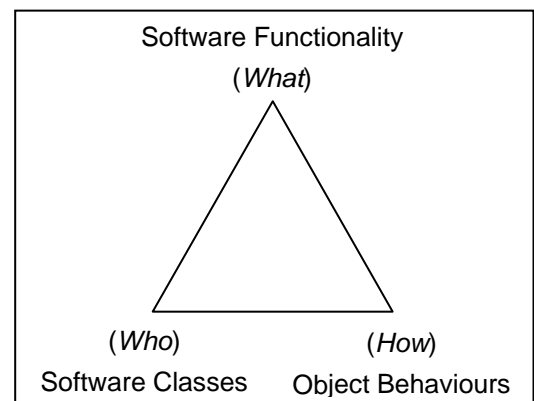


Figure 1: Object Design Model Triangle

For a simple programming task like “write a program to add 2 numbers”, the functionality is virtually identical to the behaviour i.e. *add*, and one class is all that is required to have the behaviour. There is no need for any object design activity for such a simple task. But object design becomes indispensable when developing software with more complex functionality, and an individual function may be composed of several operations, whose execution requires various objects. In this case there is no direct mapping from *what* to *who*.

Essentially, goals of the object design activity include (1) to obtain a sufficient description of the software functionality, (2) to determine and design object behaviours in terms of objects' operations and collaboration (i.e. exchange of messages), and (3) to allocate the object behaviours to classes before coding them. To illustrate this, in the context of object design using UML the *what* is elicited and represented with use cases and system sequence diagram [11], the *who* with class diagrams and the *how* with sequence diagrams. It is important for the students to be aware of that the model building activity is not *waterfall*, rather it should be an act of iteratively negotiating between the software functionality, object behaviours and classes in order to arrive at an implementable class design.

Students who do not clearly understand purposes of individual *single-sided* models and their relationship tend to make some typical kinds of shortcuts. They could have one single class to do everything, making a shortcut from *what* to *who*, bypassing the *how*. In this case their *design* doesn't provide much detail for the implementation. At another extreme, students could apply *functional decomposition* to break down the required functionality into sub-functions, seeing these as object behaviours, then equate the behaviours with classes. In such case a shortcut is made from *how* to *who*, without allocating operations to appropriate classes. This results in an error as discussed above when students having classes *Borrow*, *Return* and *Pay fines*.

From this analysis it can be seen that in order to achieve a useful object design it is not only the separate models of what, how and who that are necessary, but so are their relationships.

Model traceability is a relationship between two modelling artefacts that implies the source, derivation, or dependencies between the artefacts. Particularly, in an OO process the model traceability means that models built in a subsequent stage should be based on the related models created from the precedent stages.

It is the loss of the model traceability that makes an OO process broken, which is the main reason why our students had the problem identified in Section 2.

4. ENFORCING MODEL TRACEABILITY FOR EFFECTIVE LEARNING OF OO DESIGN

The main benefit of following an OO process is that it provides a prescriptive route to methodically perform stepwise transitions from the software functionality to the software class design. In order to fully benefit from an OO process it is crucial that the model traceability is maintained across its stages.

It is worth noting that it was not our aim to devise a new OO method to achieve the model traceability because this has been the aim of every existing OO methodology and CASE tool. Rather, what we aim for is an effective pedagogical approach. This approach places an emphasis on the issue of model traceability in teaching & learning of OO design, and uses a combination of pedagogical measures to enable students to be aware of and to maintain the model traceability throughout an OO process. As a result, they can truly grasp the essence of the OO design and to appreciate its benefits.

In order to achieve our aim, we do the following in terms of teaching and learning method. Firstly, to teach students - at the conceptual level - to clearly distinguish software functionality and software classes. It is equally important that students should clearly distinguish between domain classes and software classes, despite the fact that most of the software classes are derived from domain classes. It is through an OO design process that OO programmers are to make stepwise transitions from domain classes and software functionality to software classes. Secondly, to mentor students - at the practical level - to establish the potentially missing links in an OO process by (a) focusing on the relationship of the deliverables from one stage to the another, and (b) by sustaining the traceability throughout the entire OO process. This is facilitated by the use of a set of model templates and an explicitly written OO process-related and deliverable-related heuristics, combined with peer review to check and verify the deliverables, such as use cases, class diagrams and sequence diagrams. Additionally, two essential case studies have been used in our teaching. The first one was simple, such as a calculator simulator, to introduce key steps of an OO design process, models and their relationships in context. These would then be consolidated by a 2nd case study designed to be more complex, e.g. simulating/managing a petrol station service and transactions, which had more relationships between models, and there was no easy, direct mapping from the required functionality to software classes. As to the assessment, we used a group coursework with phased submissions of deliverables of analysis, design, and implementation in weeks 6, 9 and 12 of the semester. This required students to produce proper model artefacts from each of the stages rather than just a working program. To enforce the model traceability, it was required that the relationships (sources, derivations, and dependencies) between related models are explicitly documented.

It has been found that working in group helped our students to arrive at better OO designs (therefore the target software) as they complemented each other when forming a view of the system to be built, from requirement specification through design to implementation. In particular, groups performed really well and efficiently in “realising” use cases using CRC cards techniques [3]. The use of CRC cards helped the groups to allocate use cases’ system operations to pre-identified classes.

5. EARLY EVALUATION

We have used the described approach in our classes teaching a module entitled “Object Oriented Software Design and Development” since Spring 2007. An analysis of the module’s assessment statistics and surveys of student satisfaction suggested that the approach had worked well in terms of student performance in the module formal assessment, and contributing to improving their understanding of OO design.

5.1 Student Performance in Formal Assessment

Improved student performance in the module assessment has clearly been evidenced by a higher pass rate of the module after the introduction of the approach, while the standard of the assessment package remain the same. The assessment package is composed of a practical software development coursework and a written examination. Specifically, for the coursework students are required to design and implement a fairly *classic* business orientated application such as video rental shop management, airline seat booking or hotel room booking. Before the introduction of the approach, the pass rate in the Autumn 2005 semester was alarmingly low at only 43% with some students unable to produce any design at all and had nothing implemented. A

typical scenario was that those students with sound programming skills managed to write working software with the required functionality, but poor object design. The design was usually disparate from the UML models built in previous stages of the OO process. In the following semester, which was Spring 2006, we put more time and efforts in supporting students in terms of OO design. This had helped, but the pass rate just modestly increased to 57%, without clear indication of an improved understanding of OO design from the students.

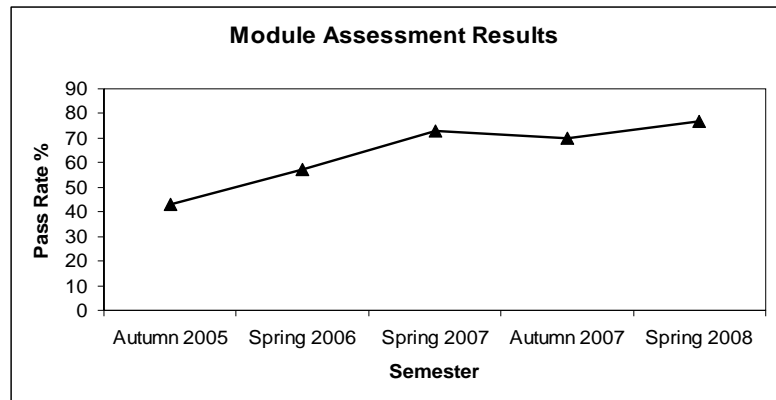


Figure 2: Assessment result statistics

The pass rate improved further after we clearly identified the problem (see section 2), and introduced the approach based on the idea of model traceability to fix it. The practical coursework was changed from individual to a group coursework in order to enforce model traceability through collaborative learning. The coursework marking scheme was adjusted to take into account individual contribution to the group work. There is also an individual face-to-face demonstration of the coursework submission at the end of the semester to assess individual student's understanding of the submitted group coursework.

As shown in Figure 2, the module pass rate jumped to 72% in the first semester of using the approach in Spring 2007, then stood at 70% in the following semester (Autumn 2007), then went up to 76% in Spring 2008 (NB: the module is not running every semester).

5.2 Appreciation of OO Design

While the module formal assessment result shows the *face value* of our approach it is more significant to note that our in-class observation and student comments have suggested that the approach is effective in helping students to gain better appreciation of OO design heuristics for the purpose of OO programming. This has been evidenced by a better understanding of object design in their coursework demonstration, and by higher rates of satisfaction for the module from student feedback end-of-semester questionnaires. The questionnaires were centrally managed by the university. Even though there was no question in the questionnaires to specifically evaluate our new teaching approach, our students did make positive comments, in the free-form section of the questionnaire, specifically referring to their experience doing the module with the approach. Figure 3 includes extracts from our student comments. There had been no negative comments with regards to the approach in discussion. The student comments also indicated that they had enjoyed a better learning experience, which was equally

- *As I have prior knowledge in Java programming I enjoyed this module. This module taught me how to think object oriented way and also now I know how to organise my Java classes.*
- *The module is perfectly designed to learn the development of OO application. I did not experience any difficulties in learning. It's very nice and interesting.*
- *Having to learn to think in object orientation. the challenge of the coursework... the feed back and how it kept me on my toes.*
- *I learned about object orientation in great extend from this module, including concepts as well as how to apply for those for practical, specially from doing coursework. I appreciate for giving me good knowledge on object orientation.*

significant for them to learn subject-related knowledge and skills.

Figure 3: Comments extracted from student questionnaires

6. RELATED WORK

Issues related to teaching object orientation has been recognised and attracted a lot of discussions at OO conferences and workshops since as early as 1996 [9,12].

According to Caspersen [5] "object-orientation, or the teaching thereof, is made complex by the following two factors: intrinsic complexity caused by the nature of the problem and accidental complexity caused by external factors such as the use of inadequate languages, tools, teaching strategies, lack of experience by teachers, and so on". The problem identified in Section 2 is largely related to the former factor, which is "intrinsic complexity". In fact, there are a plethora of research and proposed approaches to deal with it. These are methodologies for divide and conquer the complexity e.g. [10, 11], as well as modelling languages such as UML [4] for representing abstractions of problem domains, software requirements and designs. There are also

CASE tools to support most of popular OO processes [14]. However, the use of a reputable methodology or a tool usually requires as much time learning it as the time to learn the topics of an OO programming module.

Caspersen [5] has also pointed out that "there is also inherent complexity in teaching introductory object oriented programming". A number of research works in teaching object orientation at universities have been conducted and reported e.g. at ACM Computer Science Education conferences [1] and in publications such as [6]. In particular, efforts have been made to lower the "threshold for the learner in order to grasp the basic concepts". Examples of these works include: the suggestion of CRC cards by Beck and Cunningham [3], a suggested sequence of steps to teach OO design by Coplien [8]. More recent works include BlueJ [2] as a tool for teaching objects first, and light-weight modelling tools such as Violet [13] to reduce the time learning to use the tool to almost zero. There have been also works on lowering the complexity of the OO software process for the purpose of teaching OO programming such as the one presented in [6].

Although the above works have helped students and teachers to improve their practice of teaching and learning OO programming, most of the efforts have been related to fixing "accidental complexity cause by external factors" [5]. It is believed that our idea of enforcing the model traceability suggests a novel way to tackle the OO design's inherent complexity.

7. CONCLUSION AND FURTHER DEVELOPMENT

This paper presented an approach to *teaching* object oriented design, and reported our experience of using it in our classes over the last two academic years. Our approach suggested a solution to the common problem that OO learners usually got lost following an OO process. It has been found that the key to fixing this problem is that students should be taught to maintain the model traceability along the OO process - from the software functionality to software class design. Pedagogically, this is achieved by (i) building student understanding of key OO concepts and transitions in an OO process, especially relationships between the models, and (ii) acquiring practical skills through case studies and collaborative modelling with peer groups. Our practice of applying the approach suggests that it is effective in achieving the goals it was originally devised for.

Currently, we are working on several directions to improve the approach. First, we are working to determine a minimum set of essential OO concepts and process steps, yet effective with regard to the aim of the approach. Second, we believe that the use of the approach would be more efficient if facilitated by a tool. We are currently developing a web-based environment to support tutors and students to work collaboratively in real-time and to enforce model traceability during the modelling cycle. Last, but not least, a survey with a questionnaire specifically designed for gathering student feedback on the approach, its usage and benefits is also on our plan for future work.

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CREATING REUSABLE LEARNING OBJECTS FOR FIRST YEAR PROGRAMMING

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ABSTRACT

This paper reports on an on-going project exploring the use of video-based Reusable Learning Objects (RLOs) within first-year undergraduate programming courses at Newcastle University. The RLOs are intended for deployment on student-owned portable devices such as iPods or mobile phones, and are designed to reinforce discrete programming concepts common to a wide range of programming languages (e.g. objects versus classes). The pedagogical rationale and high-level aims and objectives of this work are discussed.

Keywords

Computer Programming, Software Engineering Skills, Mobile Learning, Podcasts, Video, Reusable Learning Objects.

1. INTRODUCTION

A foundation in the concepts and skills of computer programming is a core feature of every undergraduate computing degree programme [15]. Research, however, indicates that many students have problems learning to program, especially when using object-oriented languages [9, 11, 14]. To underline this concern, Jenkins and Davey [8] state that “anyone who has presented an introductory programming module will be all too familiar with students who appear to be totally unable to grasp the basic concepts”.

As a means of addressing this problem, the literature suggests that teachers need to adopt new and innovative approaches [7, 16]. Discussion focuses primarily on whether procedural or object-oriented paradigms should be taught first, but also explores other more novel approaches (such as Bennedsen’s [2] elucidation of programming processes using video). However, these techniques often fail to address the underlying problem facing the teachers: in large heterogeneous classes, it is difficult to design instruction that is beneficial for *everyone* [9].

Students come to university with varying degrees of computing experience, skills, motivations and expectations. Indeed, once a niche discipline, computing now attracts a diverse student body featuring a variety of preferred learning styles [8]. One of the challenging aspects of teaching computer programming to an audience of such mixed ability, therefore, is “how to provide the right information in the right context at the right time to the right person” [1].

Fortunately, the last few years has seen an explosive growth in mobile technologies capable of delivering “on-demand” learning content to students. iPods and mobile phones in particular have become an integral part of daily life and are a ubiquitous sight on today’s university campuses (the results of a recent undergraduate survey at Newcastle indicated 83% of our student population own and use a video-capable mobile device). The “place independence” afforded by these mobile devices can allow students to continue their learning on-the-go, utilising their otherwise “dead time” (e.g. whilst commuting, exercising, relaxing, etc.) to supplement their university studies.

With this in mind, practitioners at Newcastle University are currently looking at creating a series of “reusable learning objects” (RLOs) for use on mobile phone and iPod devices. They have designed each RLO to reinforce abstract object-oriented programming concepts and to support the school’s traditional, “object-oriented first” teaching practices. This paper discusses in-depth the development platforms and techniques adopted and briefly reports on the project’s progress and findings to date.

2. DEVELOPING AN RLO FOR USE ON MOBILE DEVICES

The primary aim of this project is the creation of a number of *visually engaging* reusable learning objects on discrete programming concepts (e.g. objects, classes, inheritance, polymorphism, encapsulation, etc.). Designed for deployment on an iPod or video-capable mobile device, each RLO will take the form of a non-interactive video-podcast for use by students “on-the-go”.

2.1 Understanding the problem

Believed by many practitioners to be the best approach, the “objects-first” strategy of teaching programming can often add an extra level of complexity to the learning process. In addition to mastering types, values and references, students must also concurrently grasp the more difficult abstract concepts of objects, classes, and encapsulation [6]. Coupled with the “one-size-fits-all” approach of teaching large classes, students who fail to grasp these fundamentals can fall behind quickly.

It is clear that many students require extra support, and with this in mind we have started to build a range of short video-tutorials designed to visualise and reinforce the most basic, abstract object-oriented concepts. We envisage that these RLOs will act as useful primers *before* traditional classroom-based instruction, as reinforcement *afterwards* and as revision aids *during* examination periods.

2.2 Creating the video

Based on an initial evaluation of the development tools and platforms available, in addition to the considerable number of animation and design assets required, we decided to develop the RLOs in Adobe Flash (using Adobe Flash 8). This provides learners with a consistent and visually rich experience which can be delivered on multiple platforms (and easily converted to video for use on mobile devices). Emphasising episodic delivery (exploring one single concept at a time), each RLO runs for approximately ten minutes, which enables the learning content to be more easily absorbed by the student and helps reduce file size and download times [5].

Driven by staff interviews, the instructional material for each “episode” derives mainly from our current introductory programming course content. As suggested by Prasolova-Førland et al. [13] and Clark et al. [4], we have embedded this content in a “familiar” visual setting; one that is analogous to the students’ real-world learning environment (i.e. an illustrated reproduction of a traditional lecture/classroom setting). The pedagogic rationale behind this design approach is simple: memory of places and visual cues can often help reduce the barriers to learning.

To continue this theme, we have also developed a “virtual tutor” to introduce and summarise the key concepts discussed in each episode (see Figure 1).

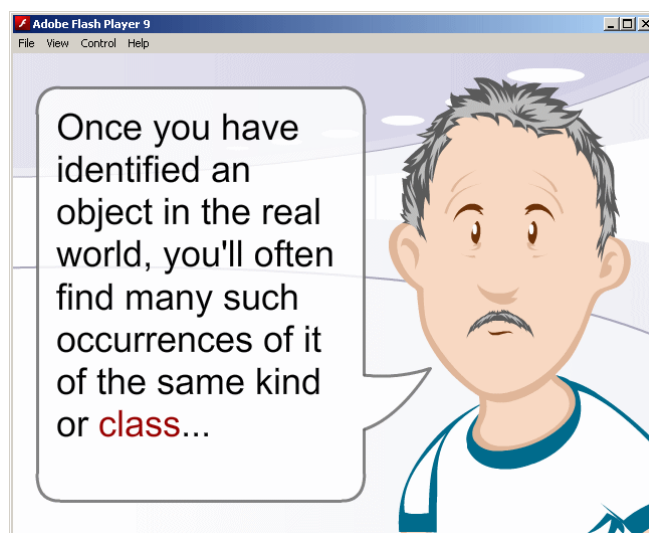


Figure 1. A tutor agent introduces key programming concepts

Furthermore, the look-and-feel of each RLO episode has been designed to appeal to an undergraduate audience, and we have used graphics in place of text wherever relevant. Indeed, as discussed by Mayer [10], the use of graphics can significantly improve learning provided they are “congruent with the instructional message”. As such, each concept introduced by the tutor is explained in detail using a combination of on-screen text, graphics and animation (see Figure 2). A great deal of effort has been spent ensuring the visuals are consistent in style and low in complexity (for use on small screens).

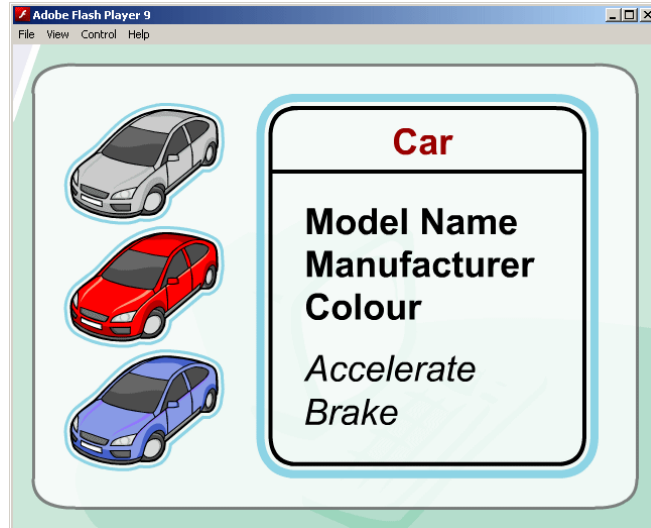


Figure 2. Learning content is shown using basic text, vivid graphics and simple animation

2.3 Adding audio to the video

Mayer [10] suggests that a learning agent is especially effective when its instructional advice is presented in both audio and text rather than by text alone. This is especially the case when students believe they are “active participants” in the agent’s dialogue. Indeed, Campbell [3] highlights the importance of the “explaining voice” in providing understanding and meaning in the learning process, arguing that written information may have little meaning until it is heard.

As a result of these findings, we have created a ten-minute script for each RLO episode using an informal, conversational style of language. Based in the first and second person, the narrative features a more natural tone and helps the student feel actively engaged in the learning process. A member of our staff voices each script and recorded using a simple microphone and PC-based sound editing suite. We recommend Audacity for this purpose due to its availability, ease-of-use, and capacity to export sound in MP3 format.

To ensure a professional, captivating product, we have also incorporated music and sound effects at key points throughout each episode. There are many excellent sources of “free” music and sounds available on the Internet for just this purpose, provided you adhere to their usage policies. Of note, we found it particularly helpful to record the audio before creating the Flash animation, as this allows for easier synchronisation between the two. Once the animation has been timed correctly and exported from Flash in video format, the audio can be easily added using Apple’s QuickTime.

2.4 Adding interactivity

Video and audio-based learning resources are often seen as a “passive medium”, incapable of supporting student interaction. However, as Mayer [10] reminds us, meaningful learning outcomes simply occur as a result of activity during the learning process, whether hands-on or simply in the student’s mind. As such, at key points during each episode, we give learners the opportunity to reflect upon the content and to apply their tacit knowledge to a real-world problem.

We achieve this by embedding “time-outs” into the instructional content; brief breaks in which students can review and reinforce their learning in a situational context, through the simple observation and analysis of their immediate surroundings (see Figure 3 overleaf). This simple approach permits a small degree of “interaction” on devices with little scope for user-input (e.g. iPods). It also greatly benefits kinaesthetic learners, who learn best from “hands-on” interaction and by actively investigating their environment [12]. To mark the beginning and end of each “time-out” period, audio cues and visual transitions are used.

2.5 Distribution

The finished Adobe Flash animation file, when compiled, can be placed as-is on a website for online viewing, or exported from the Flash in a mobile-device-compatible video format (e.g. MP4) for use on iPods, mobile phones, PDAs, portable gaming machines, and so on. The Flash project files themselves have been made available as a basis for further RLO development, and we have provided all images, text and illustrations in an external library for easy reuse.

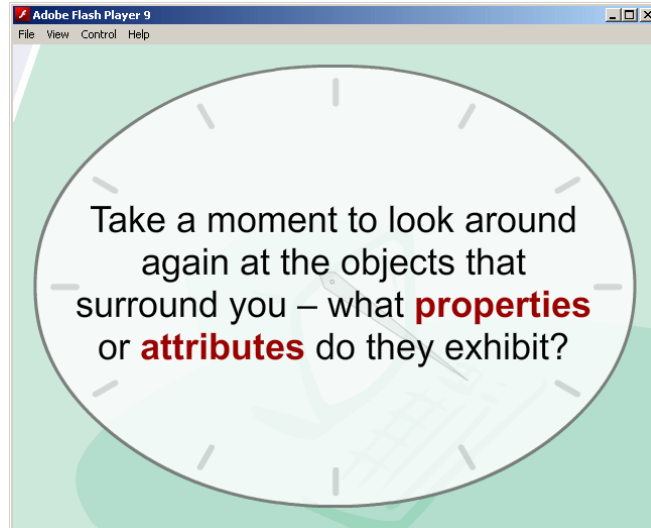


Figure 3. Students get time to reflect and consider problems

At present, students can download the video files from our local website and place them on their mobile devices manually. However, once the full suite of learning objects is complete it is our intention to package each RLO as a “video podcast” for true episodic delivery and syndicated download.

2.6 iQuiz

In addition to the primary instructional content, we have developed a ten-question iQuiz to complement each episode. An iQuiz is an interactive game that utilises the iPod’s built-in quiz functionality (and is thus limited to that platform), and features true/false and multiple choice question types. The “just-for-fun” quizzes allow the student to review, revise and test their basic understanding of key object-oriented concepts (see Figure 4).

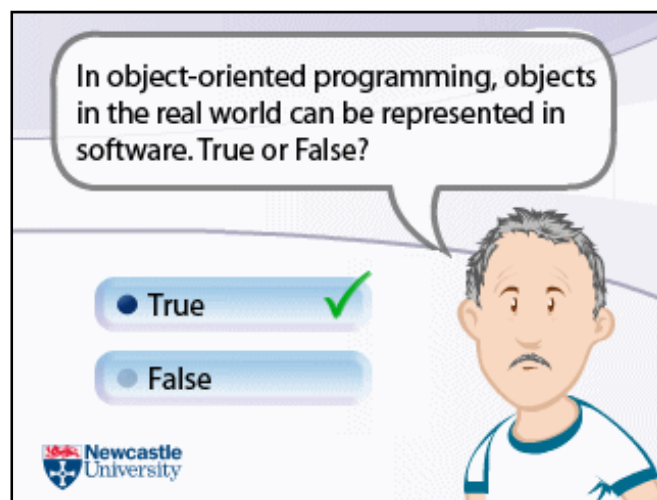


Figure 4. Each episode has an iQuiz to review key concepts

Creating an iQuiz is surprisingly easy, and just involves building a “trivia pack” for students to download to their iPod. In its simplest form, the pack consists of a text file containing questions and answers – however, we chose to add custom graphics to ensure a consistent graphical theme across our products.

3 EARLY FINDINGS AND FUTURE WORK

To date, we’ve successfully created one full “evaluation” RLO and accompanying revision quiz (objects versus classes), with another nearing completion. Each object requires a high degree of graphical content and animation, and this has delayed progress somewhat. However, the framework and graphical assets developed so far stand as an important outcome of this initial stage of work and will help streamline future development.

More encouragingly, feedback from students testing our evaluation releases has been extremely positive. The majority of second year computing science undergraduates asked to review the RLOs commented that the supplementary content provided a great way to reinforce the topics covered in class, and would make ideal revision aids. The majority also felt that, although largely passive, the learning content managed to engage them and encourage critical, independent thinking. Further research is needed to explore more fully the student's opinions of each RLO and their impact on the learning process, which will occur as we release subsequent episodes.

Of note, student surveys have shown that the majority of our students own and regularly use a mobile, video-capable device, but it would be unfair to ignore the subset that doesn't. Therefore, the video content has been created in such a way that it is playable on any personal computer.

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BEYOND GOOGLE: HELPING LIBRARY/INFORMATION PROFESSIONALS WORK WITH THE GOOGLE GENERATION

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ABSTRACT

This paper outlines a Higher Education Academy (HEA)-funded project undertaken by the authors, the output of which was a video designed to help library and information professionals in their work with younger users. While many young people are confident users of the Internet as a tool for communication and sharing information, it should not be assumed they are also competent seekers, finders and evaluators of information. There is a growing realisation that the myriad of information sources on the Internet and the increasing number of tools to find and filter information may be confusing to inexperienced users. An important role for library and information professionals is to help users make sense of this complexity. After outlining some of these issues this paper describes the authors' project and the feedback it received from its viewers in the library and information community.

Keywords

Information literacy, Google generation, library and information professionals, video, training.

1. INTRODUCTION

There is a growing realisation that just because many people under 25 are avid users of Web applications such as Facebook, MySpace and instant messaging they are not necessarily skilled in using all types of digital information services. Tapscott's [1] notion of a generation growing up "bathed in digital bits" and, as a consequence, being able to confidently multitask activities such as online research, analysis and producing written work is rather simplistic and does little to expose some of the issues facing those academics and librarians responsible for educating this generation. The British Library and JISC commissioned research carried out by the Centre for Information Behaviour and the Evaluation of Research (CIBER) [2] that overturns assumptions that this Google generation is the most Web literate. These young people may have a strong familiarity with computers and use the Web frequently but they rely heavily on search engines and lack the critical and analytical skills needed to assess the information they find on the Web.

This paper has emerged from an HEA-funded project that the authors undertook in 2007/08 which sought to explore some of the issues facing library and information professionals as they grapple with serving their "digitally bathed" users. The paper will outline some of the current key thinking in the information literacy (IL) sphere as a background and then move on to describe the HEA video project and how it was received by the library and information studies (LIS) community. The paper will conclude with some thoughts on how future projects in this area may be constructed.

2. PERCEPTIONS OF INFORMATION LITERACY

Discussions around the area of information literacy, particularly within the context of the library and information profession, really began to gain momentum in the 1990s. Part of the reason for this may have been the growing use of electronic information services by end users and resulting disintermediation of library and information professionals. Judgments about the veracity of sources and strategies for finding information were starting to move away from those with years of experience of filtering and searching sources to users. Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission.

with little or no understanding of the importance of these issues. As the Internet became established as a key tool for accessing information and networked computers were widely deployed in libraries, the workplace and the home it soon became apparent that simply providing Internet access to those seeking information was not the answer [3]. A variety of terms emerged to describe the challenges facing both end users of information and those tasked with helping them to locate the resources they needed.

Bawden [4] describes the key terms used and explains the context from which they emerged. Information literacy became the dominant phrase used within the literature but other, more granular, terms also entered the vocabulary. According to Bawden these included computer literacy, library literacy, media literacy and digital literacy. There is considerable overlap between many of these terms with digital literacy, for example, sometimes being used to refer to a person's understanding of digital information resources as well as pertaining to their broader competence with information technology hardware. This ambiguity is largely inevitable as the literature around these discussions is still evolving and as new technologies seem to emerge with increasing frequency.

Since the mid 1990s there has been ongoing discussion and development of the work of Christine Bruce [5] who analysed various approaches to information literacy and, taking a phenomenological approach to her research, presented a range of "conceptions" of IL, including the information technology conception, the information control conception, the knowledge extension conception. Her "relational" model demonstrates information literacy in terms of relations between people and information, and represents IL as it is experienced.

Whatever the term that is used to define it, and however other colleagues and library users within our organisations might perceive or understand it, librarians have identified an increasingly urgent need to provide help for information users navigating the growing amount of information in its increasingly diverse forms. Library and information professionals have designed strategies for achieving this in the most effective ways, not least educating themselves in how best to educate their users.

3. APPROACHES TO TRAINING LIBRARY AND INFORMATION PROFESSIONALS

Whether librarians are operating in the workplace [6], the public library [7] or in an academic environment [8], there is a growing need for them to be able to show users how to find relevant information for themselves. In many instances this requires the librarian to run training programmes in information skills, something which many library and information professionals have not experienced or been explicitly trained to do. Library and information courses, on which both authors teach, have not traditionally offered modules on developing and running training programmes, although one of Mokhtar's [9] recommendations with regard to teaching information literacy is that "IL educators be equipped with pedagogical training in addition to their discipline knowledge in LIS, which generally promotes user-centred approaches".

During the 1990s, the JISC-funded Electronic Libraries (eLib) programme produced, amongst other outputs, a series of library projects focused on training and awareness within the increasingly electronic environment, of which the EduLib project was particularly successful. EduLib aimed "to provide librarians with the opportunity to acquire, or further develop their existing educational skills in order to ensure the design and delivery of effective training programmes" [10]. It was to be achieved by developing a nationally recognised and accredited network of library trainers who possessed skills in both the exploitation of networked information and the pedagogy required to make the use of electronic libraries an everyday part of learning, teaching and research. The focus was not on information literacy, per se, but on the pedagogic knowledge and understanding that librarians would need in order to be able to deliver appropriate educational experiences for users trying to make sense of finding, evaluating and using information.

Almost a decade later librarians are making use of the Web itself to promote the same cause. The Infoteach¹ wiki is the outcome of a National Teaching Fellowship Scheme award, the aim of which is to play a part in enabling librarians and information workers, in every sector, to be competent teachers and facilitators of learning.

Members of the UK wide Information Literacy Group, a sub group of the Chartered Institute of Library and Information Professionals (CILIP), have developed a web site that brings together research and activities being developed by librarians across the country. One of the more well known outputs is LolliPop², an online tutorial that aims to enhance the information literacy skills of enquiry desk staff working in libraries.

¹ www.infoteach.org

² <http://www.lobelollipop.com/login/index.php>

4. THE “BEYOND GOOGLE” PROJECT

But what do our academic colleagues, our users and other librarians have to say about information literacy (or whatever they prefer to call it)? How can we use their views to help educate library staff about the best ways to help their users to navigate their way through the myriad of information sources made available by the rise of the Web, and in evaluating and using the sources found?

At a meeting of the LINES³ Information Literacy Community of Practice in early 2007 the authors agreed to produce a short video that would help library and information students as well as practising librarians better understand the value of offering training sessions as well as providing practical suggestions for how they might be designed and run. The main aims of the video were: to provide practical advice and guidance on how library and information professionals can demonstrate to end users the value of information resources beyond the public Internet; to explain some of the key benefits for end users of using structured databases as sources of information; to explore some of the current strategies adopted by University students when looking for information to help with their coursework.

The resulting 10 minute production includes short interviews with students who shared their views and experiences of using the Internet as a research tool for finding course-related information. These were complemented by interviews with academics and librarians where the discussion focused on how they help students and other library users appreciate the benefits of using the many online, high quality (and often expensive) resources available through the library rather than heading straight for Google. The video also includes a practical demonstration of some of the advantages of using a structured, subscription-based database over a standard Internet search engine and a series of tips and guidance for librarians and information professionals on organizing training sessions for library users.

The video format was chosen because it could be re-used and delivered via the Internet⁴ and on hard media such as DVD. It could be used by university academics teaching LIS students or, equally, by library staff organising or undertaking training (see below). The value of the format is the ability to link theory with practice in a direct and interactive way, and one that is used successfully in other areas of training such as providing appropriate support to disabled users [11] or dealing with difficult users.

Videos are effective in helping to stimulate discussion, to share information and, by extension, to encourage more active learning. [12]. The desire to cater more effectively to visual literacy is gaining momentum, not least because Web 2.0 tools facilitate this [13]. Bull suggests that placing videos on the Web can support the learning context by setting video resources among specific communities of learners [14]. The characteristics of YouTube are appropriate for a video that aims to appeal to both learners, teachers and practitioners in that most content is available to all users, the tags/keywords can help people to find related videos, and user comments/ratings on the content are available. Indeed, Duffy [15] stresses that "video can be a powerful educational and motivational tool", not as an end in itself but as a means of achieving learning goals and objectives by the way in which it is used. Clark and Mayer (quoted in Duffy) assert that "educators (and students) alike will find that video is an effective catalyst and facilitator for classroom discourse and analysis". Guidelines are offered relating to the specific use of video to promote active viewing and to maximise learning [15]. Trier [16] proposes in detail how YouTube videos can be incorporated into teaching (or, by extension, training) and suggests that there is a distinctly "cool" element to this.

5. SUGGESTIONS FOR USE OF THE VIDEO

The format can facilitate discussion with library staff or library and information science students (LIS), for example, by playing the talking heads section as a trigger to ask pertinent questions about the understanding and ideas being conveyed.

The section of the video that includes a practical demonstration of the benefits of a structured database over an internet search engine could lead to an activity whereby participants in the training are asked to prepare a different example from the one shown on the video that meets the needs of a particular user group or subject search. This could involve them doing a demonstration to the rest of the group, indicating the key points they are trying to convey. Their peers could then assess both the persuasiveness of the demonstration and the approach taken.

³ The Library and Information Management Employability Skills project was funded by the FDL5 and aimed to facilitate skills development during initial professional education by creating learning and teaching materials which reflect employability skills and by embedding them within the curriculum. <http://www.ics.heacademy.ac.uk/limes/CONTENT/index.htm>

⁴ <http://www.youtube.com/watch?v=RIZNkKLssqM>

The list of suggestions to bear in mind when preparing and undertaking a training session with library users is, in the video, necessarily brief. It could be used, therefore, to get the participants to think of additional ideas (i.e. “tips”), by discussing this in groups and bringing their own experience of learning situations, or of working at library service points where they might have dealt with library users struggling to find information.

6. FEEDBACK ON THE VIDEO

The video was released in the summer of 2008 and over 100 copies of the DVD were sent to library schools and practising librarians who requested copies following a short feature in the CILIP Gazette⁵. It was also posted to YouTube and by the end of March 2009 had been viewed over 1,700 times. In early 2009 the authors requested feedback⁶ from those who had used and viewed the video to ascertain where it had been useful but also how it could be improved in future versions, and also checked out reaction to it on various blogs. Godwin [17] is clearly an advocate of using Web 2.0 in library practice and commented on his blog that he would have liked the video to have covered “more about ways of employing wikis, blogs, and video material from YouTube, podcasts, etc.” This is a clear steer for future work.⁷ Figure 2 summarises the comments of the 28 people who responded directly with feedback and could be useful as the basis of a framework for anyone considering developing their own training programmes and initiatives in this area.

| Positive | Negative | Suggestions |
|--|---|--|
| <ul style="list-style-type: none"> • Useful for stimulating discussion amongst library assistants; • Raised awareness amongst colleagues that this was a common problem for librarians; • Useful practical tips for running a training session; • Useful for CILIP members seeking Chartership; • Video validated what some librarians were doing correctly; • Useful introduction for new library assistants; • Interviews with staff and students were very useful and add weight to the discussion; • Short, concise and useful practical advice. | <ul style="list-style-type: none"> • Video too short to justify a public screening; • Production values, particularly sounds, could be improved; • Too much conversation and not enough hard advice. | <ul style="list-style-type: none"> • More advanced searching techniques; • For institutions that do not have access to subscription databases some more information on free alternatives would be useful; • Would be better as 2 separate videos – one for helping students search the Internet and one for running training sessions; • Some more positive tips on when Google is useful; • More tips and examples of good practice; • A different version aimed just at schools; • Issue of Deep Web could be further explored; • Would be useful to cover Google Books and Scholar. |

Figure 2 Summary of Feedback from Beyond Google video

From the comments summarised in Figure 2, there seems to have been a generally positive reception to the video with a range of useful suggestions for possible future productions. One of the themes running through much of the feedback is how the video was useful in starting discussions amongst library and information staff on the subject of information literacy and their users, and particularly non-qualified staff. This is clearly an issue that needs further debate but because the technology is changing so rapidly many library and information professionals and academics are struggling to keep abreast with the rapidly changing information landscape. Part of the solution may be for information vendors, search engine providers and the library and information profession to work more closely together so that end users of information can more easily navigate their ways to the most appropriate sources. Several of the video viewers made the point that it would be useful for future training videos to show where Google and other Web services have got it right rather than simply focusing on some of the negative aspects. This is an important point and highlights the need for information professionals to explain to users in what circumstances tools such as Wikipedia and Google are appropriate. In the case of Google this is particularly relevant as the search giant develops new services such as Google Scholar, News and Books.

⁵ The CILIP Gazette is the fortnightly magazine for members of the Chartered Institute of Library and Information Professionals

⁶ Emails were sent to the 105 people who had received a copy of the DVD asking for their comments on how they had used the video, feedback from viewers, if they found it useful and suggestions for changes to future versions.

⁷ The authors are currently considering the production of future training aids in this area

7. THE FUTURE

In the course of producing the "Beyond Google" video, the authors interacted with a number of library and information professionals as well as drawing on their own experiences as practitioners and academics. These interactions have clearly demonstrated that the issue of information literacy is one of the key challenges facing the profession and is placing increasing pressure on those responsible for helping users find the information they need, whatever the kind of library. As new Web services and technology platforms emerge these pressures are only likely to increase. Assuming that anyone born since 1990 is a "digital native" can be dangerous as for some people as this implies that young people are confident users of the Internet and do not need help from information professionals, but, as the CIBER report [2] indicates, even experienced researchers demonstrate the same characteristics of impatience in search and navigation and therefore libraries need to respond urgently to the changing needs of all their users. If the experiences of those who took part in the video are broadly representative, there has never been a greater need for experienced library and information professionals to act as guides through the increasingly complex digital maze.

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SIRLEARNALOT

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ABSTRACT

Librarians in all sectors are now expected to teach readers how to search effectively for and ethically use good quality information. Teaching readers' information literacy competencies can take place at the enquiry desk or in a formal classroom setting. Very few information science courses prepare librarians for the teaching role they will undertake. In this paper, the SirLearnaLot project is outlined. SirLearnaLot is an online tutorial designed to enhance librarians' teaching skills. This paper outlines the aims & objectives of the project and progress to date, including a brief summary of the informal pilot and future actions.

Keywords

Information literacy; teaching; learning; pedagogy; libraries.

1. INTRODUCTION

Since the 1970's Higher Education (HE) libraries in the United Kingdom (UK) have been teaching students how to use their resources. This process was often known as bibliographic instruction or user education and generally focused on the mechanics of how to use specific resources owned by a particular library. This blossomed into teaching readers problem solving techniques that could be transferred to any information problem or library; this is often known as information literacy. Information literacy teaching takes place on both a one-to-one basis at an enquiry desk and in groups in the classroom. In addition, some UK HE libraries have been and still are actively involved in teaching students how to enhance their study skills.

1.1 Information Literacy

The Chartered Institute of Information and Library Professionals (CILIP) defines Information Literacy as "knowing when and why you need information, where to find it, and how to evaluate, use and communicate it in an ethical manner." [1] With the growth of digital information, the ability to find and use information has become increasingly important. This has recently been recognized by the government in the Digital Britain report, which refers to "Digital Life Skills – needed by all" through to "Digital Work Skills – needed by most" [2], but which provides no real definition for these terms. Thus in the UK, information literacy is no longer seen as the province of HE libraries and all education and public libraries are beginning to realise the role they can play in developing readers' information literacy so that they can actively engage in the digital society.

Teaching and training has become a core part of a librarian's role. Courses are being designed and delivered by library staff to readers on various topics and in various formats, including face-to-face, online, blended learning, in formal classroom time and informally on the enquiry desk. Library staff are expected to be effective teachers in the classroom and at the enquiry desk. The question is, how do library staff acquire these skills?

1.2 Teaching skills and librarians

The issue of how librarians gain skills that will assist them in the role of educator has been in discussion for a long time. Library and information science courses until recently did not teach librarians how to teach, and many still do not even today. Helen Conroy[3, 4] on the behalf the (CILIP) Personnel, Training and Education Group (PTEG), the CILIP Community Services Information Literacy Special Interest Group (ILG) and Netskills, carried out a survey in 2007 to discover whether library staff were teaching and how they gained teaching skills. There were 463 responses to the survey, mostly from the HE sector, but there were a small number of responses from other sectors. Conroy discovered that over half the respondents spent 20 to 40% of their time undertaking teaching activities and that teaching ranged from on-the-spot support to large group teaching. Respondents developed their teaching skills through: trial and error (72%), on the job (59%) and accredited courses (30%). Accredited courses included PGCE, City & Guilds, PGCLTHE and pathways for membership of the Higher Education Academy (HEA). The survey discovered that cost and flexibility were chief factors in deciding what course to go on. There was also a desire for library focused teaching courses as respondents felt that it placed the theory of teaching into context.

The Follett report[5] in 1993 recognised the role libraries would play in ensuring that IT and electronic information was exploited in learning and teaching in the UK HE sector. To assist this, the Joint Information Systems Committee (JISC) funded a stream of projects under the Electronic Libraries Programme (eLib). The aim of eLib was to “transform the use and storage of knowledge in higher education institutions”[6]. As part of this programme a consortia of HE libraries and educators ran the Educational Development for Higher Education Library Staff (EduLib) project. The principle aim of EduLib was to “enhance educational expertise and teaching skills in the higher education library and community services community”[7]. The project produced a network of trainers and teaching materials that could be used in HE library staff development workshops. EduLib made a significant impact on the teaching skills of HE librarians, but had little impact on those working in school, further education colleges, commercial and public sector libraries, despite some of the Development Officers offering and running courses for library staff in these sectors.

Information Science Departments are beginning to recognise a need for both information literacy and teaching skills within the curriculum. Very few are actively developing librarians' teaching skills, although there are exceptions to this. The LIMES project funded by the HEA Information and Computing Sciences (ICS) Subject Centre aimed “to bring together the expertise and knowledge of academics and practitioners in order to enhance the quality of teaching materials available to library and information departments.”[8]. To achieve this aim they created several communities of practice, one of which related to information literacy. The community of practice included academics and practitioner librarians. At a meeting in 2007 it was agreed that the participants would create resources designed to enhance librarians' teaching skills. For example, the academics have produced videos/DVDs that can be used in academic teaching and Barbara Chivers created course materials that are available in through the HEA ICS's re-useable learning objects repository. The practitioner librarians agreed to investigate whether the EduLib material could be re-purposed for delivery in an online environment to librarians working in all sectors.

2 EDULIB ARISING FROM THE ASHES

2.1 EduLib

As stated previously, EduLib was funded under the JISC eLib programme. From August 1995 to August 1999 EduLib created a cascading training programme that aimed to enhance HE librarians teaching skills. The project team developed and delivered training throughout the UK. They also produced print material that was designed to help the trainers deliver workshops to librarians on how to teach. The material included lesson plans, suggested slides, handouts and further reading.

The EduLib programme developed nine workshops: Understanding learning, the nature of teaching, Planning a teaching & learning event, Observing teaching, Teaching methods (small & large groups), Reviewing learning & assessment, Diversity, individual differences & equality, Information technology in learning & teaching and Open and distance learning.

The EduLib Development Officers pro-actively trained staff in their own institutions, but only a few offered a substantial amount of training beyond their own institutions. There were exceptions, one or two delivered courses for a whole range of institutions and sectors. It can also be argued that EduLib encouraged or gave Academic / Subject Librarians the confidence to attend other teaching courses, especially those offered within HE institutions. In addition many books on information literacy have been clearly influenced by EduLib.

2.2 SirLearnaLot

A partnership of librarians from HE institutions (see section 4 for details of the project partners) won funding under the HEA ICS Development fund to re-purpose EduLib for the digital age. A nominal amount of funding was also received from the CILIP CSG Information Literacy Group to pump prime the project.

The aim of SirLearnaLot is to develop an online course that will teach librarians how to design, deliver and assess courses that enhance readers' information literacy and study skills. Although the material is principally aimed at librarians already in employment, it could be used by Information Science Departments to teach their students how to teach.

All the project partners were experienced librarians and teachers. In addition Chris Powis had been a member of the original EduLib project team and brought expertise and guidance on the areas which were particularly successful and those which required additional work along with first hand experience of what librarians wanted to know about teaching.

Only one face-to-face meeting was held to agree the project partnership and develop a project plan. All other communication was undertaken via e-mail. In the long term this did cause problems, as all project partners suffer from email overload and on occasion messages were responded to late or not at all. In addition the project timescales agreed proved to be unrealistic and due to existing work commitments, the project timescales slipped.

2.2.1 Copyright

Copyright permission was sought from JISC and the editors of the EduLib print toolkit to re-use the EduLib material. Sadly JISC never responded to telephone calls or emails. Verbal agreement from one of the editors was received. As copyright permission had not been obtained from all parties involved in EduLib, the material was used as inspiration and new material written.

2.2.2 Developing SirLearnaLot

SirLearnaLot is divided into an introductory unit and seven subject specific units:

- Tools for learning
- Unit 1: Understanding learning;
- Unit 2: Teaching – planning a learning event;
- Unit 3: Teaching – delivering a learning event;
- Unit 4: Resource to support teaching;
- Unit 5: Assessment;
- Unit 6: Evaluation;
- Unit 7: Information literacy.

The units were created in html using cascading styles sheets and templates, they can therefore be uploaded into any Virtual Learning Environment. A variety of additional learning materials were created, including: Word documents, short videos and Informs tutorials.

SirLearnaLot is designed so that institutions can download the materials and deliver them to staff as a set of web pages or through embedding them into a VLE. SirLearnaLot can be delivered wholly online with no face-to-face teaching or part of a blended learning environment. The delivery of the programme is determined by the institution delivering the course.

When designing the programme the project team tried to ensure:

- That it was not too text heavy[9];
- That it was clearly signposted with a logical sequence for topics[10], but that students could move around the programme in any order they choose, allowing them to return to sections if they wish[11];
- Included activities that encourage reflection and discussion[12];
- That units / sections would not take too long to complete as students can have short attention spans[13].

Activities included reviewing existing material (books, web sites etc.), creation of learning outcomes, lesson plans and supporting teaching material. Reflection was / is encouraged by asking participants to relate theory to their own experiences, using online discussion forums and a wiki to share their thoughts and a learning journal to record their feelings in relation to their teaching.

2.2.3 Delivery and evaluation of SirLearnaLot

SirLearnaLot has been delivered on an informal basis to a small group of staff at Loughborough University Library. The staff were asked to undertake the course and feedback on content, pitch and appropriateness of activities. Feedback was generally positive, but the following issues were identified:

- Despite editing, each unit had a different 'voice' and participants felt it would be better if there was one voice;
- Some units required substantially more work than others and participants felt that the units should require similar amount of effort;
- One unit felt more like a journal article due to all the references and it was felt it needed more activity, but there was also a request for more links to the literature in the other units;
- Some of the units relied heavily on reflection and discussion and it was felt that a greater variety of learning materials or activities would be beneficial;
- The order of the units was questioned with a suggestion that the information literacy unit should move to earlier on in the programme;
- Most units were pitched at the correct level, but Unit 1: Understanding learning; and Unit 7: Information literacy may be intimidating for librarians new to teaching.

3. THE FUTURE

Despite some Information Science Departments introducing information literacy and teaching skills into the curriculum, there is evidence that librarians would like the opportunity to develop their teaching skills while working. There is therefore still a place for SirLearnaLot in continuing professional development.

Work has begun on revising the programme based on the feedback received to date. A formal pilot with participants from a range of UK HE institutions is planned for summer 2009. A detailed evaluation strategy has been developed which includes pre and post surveys, focus groups and analysis of the learning diaries and discussion forums. It is hoped that SirLearnaLot will then be rolled out to the library community as a whole. A copy of the material created will be placed with the HEA ICS and CILIP IL group for re-use under the Creative Commons License.

The development of SirLearnaLot has been promoted to librarians at LILAC 2008 and the World Library and Information Congress: 74th IFLA General Conference and Council. It generated a lot of interest and discussion. From this discussion it has become obvious that librarians / institutions would appreciate the programme being offered in more than one way. Some institutions are large and have the correct support to download, adapt and run the course themselves. Other institutions are small and would prefer for the course to be run externally. Discussions are underway with CILIP PTEG who wish to use SirLearnaLot as an aid to the face-to-face courses they wish to run for librarians on how to teach information literacy. Interest has also been expressed in the course being accredited with a certificate being available on successful completion and / or membership of the HEA. The project group plan to investigate with both CILIP and HEA the possibility of accreditation for SirLearnaLot.

SirLearnaLot is and always will be a work in progress, as this is in essence the nature of the online course. Every time the course it is delivered, it will be adapted and improved upon.

4. PROJECT MEMBERS

The project members were:

- Moira Bent, Newcastle University;
- Debbi Boden, University of Worcester;
- Ginny Franklin, Loughborough University;
- Chris Powis, University of Northampton;
- Tracy Marshall, Loughborough University;
- Jane Secker, London School of Economics;
- Ruth Stubbings, Loughborough University;
- Marcus Woolley, University of Bedfordshire.

5. AVAILABILITY OF SIRLEARNALOT

SirLearnaLot is currently available from <http://www.lilacconference.com/sirlearnalot/> Visitors are welcome to view the programme. Username = guest1, password = guest. In the near future institutions / organisations will be able to download and use the programme under the Creative Commons Licence.

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PARTICIPATION RATES IN CS: ONE INTERNATIONAL ISSUE OR A MULTIPLICITY OF NATIONAL ONES?

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ABSTRACT

The proportion of female students studying Computing related subjects at undergraduate-degree level is decreasing. This decline in the number of female applicants for Computer Science (CS) degree programs is undoubtedly worrying. In the early 1980s some 35% of applicants for CS degrees at UK Universities were women, but now the figure is closer to 10%; this statistic is not confined to one country. Some countries such as Ireland and India do buck the trend, but is there a commonality between the decreases seen in many countries?

As individuals, we undertake work based upon our own students, or students from our own country but rarely if ever seek international comparisons. If we are to work effectively together across nationalities we need to determine whether we are all suffering the same problem or different problems with the same symptom. This paper presents the results of an international comparison of student interviews.

Keywords

Gender, recruitment.

1. INTRODUCTION

The image of computer scientists and programmers is well known in the media: the brilliant but socially inept mumbler who could use a few tips on hairstyles and clothes. Claudia Morrell suggests that “girls in particular don’t want to be perceived as geeks and nerds” [1]. Increasing numbers of girls are using the internet and email for personal reasons, but still they are not interested in higher level education or careers in Computing. As a discipline we need to harness the best available talent, male or female, and encourage them to make the transition from using computers for personal reasons to considering Computing as a career.

In 2001, a UK investigation was undertaken into why Computing degree programs were attracting fewer and fewer female applicants [4, 5]. Many female students were interviewed, and an understanding of why we were attracting declining numbers of female applicants began to emerge: female students were choosing academic disciplines with a visibly social dimension and where female role models are more readily accessible.

Several years later, student numbers on Computing courses are much lower; the proportion of female students is starting to decline further *and* they are part of a much smaller cohort.

2. THE PROJECT

In order to determine whether our students perceive the same issues affecting their subject choice, and the importance they attach to them we have interviewed students from our own institutions. This represents six institutions from three different countries. It should be enough to further our understanding and provide guidance for further research in the area.

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2.1 Methodology

We applied a qualitative methodology to the study, undertaking semi-structured interviews with six pairs of first year students. The questions we asked were based upon an agreed list of themes for consistency and comparability. The students were interviewed in same-sex pairs; four female students and two male from each institution. The questions were based loosely around the following themes: why they chose their Computing course; what they were expecting it to be like; what it is actually like; did they know the gender ratio before arriving at university?; is it a problem / issue?;

The students' responses were recorded and transcribed to provide direct quotations. This allows a comparison between students from different countries. Previous work has shown that it is profitable to pool information gleaned from students from different institutions [2, 3, 4, 6]. Respondent validation was essential in order to ensure that the data collected by the interviewers was accurate. We compared and contrasted their comments within the contexts of the different institutions and national educational systems.

3. WHO ARE WE?

Here we provide a brief introduction to the institutions involved to illustrate the contexts in which we use the student responses.

3.1 UK

There are three UK universities involved in this study: the Universities of Kent and Leeds (England), and the University of Ulster (Northern Ireland).

University of Kent – The University of Kent's Canterbury campus was granted its charter in 1965, with other sites being more recent additions. The Canterbury campus supports student community of 10,000 undergraduate and postgraduate students from over 120 nationalities.

University of Leeds – The University of Leeds came into being in 1904 but its origins go back to the nineteenth century with the founding of the Leeds School of Medicine in 1831 and then the Yorkshire College of Science in 1874. It is the second largest university in the UK, with over 30,000 students from over 130 countries.

University of Ulster – Over 23,000 local, national and international students study at the four campuses: Coleraine, Jordanstown, Belfast, and Magee. The School of Computing and Mathematics is based at the Jordanstown campus, which was founded in 1972.

3.2 USA

The United States does not have a central authority exercising control over colleges and universities; instead each state is responsible for governing the institutions that reside within their borders. Most colleges and universities use the results of two privately developed admissions examinations – the SAT and ACT in their acceptance process.

There are two US universities involved in this study: Central Connecticut State University and the Rochester Institute of Technology.

Central Connecticut State University –CCSU was founded in 1849 and is the oldest and largest publicly supported institution of higher education in Connecticut, with more than 12,000 undergraduate and postgraduate students.

Rochester Institute of Technology – RIT was founded in 1829. It is a private university that enrolls approximately 16,000 undergraduate and postgraduate students from over 90 countries.

3.3 Australia

The Australian university application system is similar to the UK's, although each state has a different Admissions Centre. Bachelor degree courses are usually offered out of universities, other qualifications from TAFE (Technical and Further Education) Institutions, which may be aligned with a university or stand alone. The selection process is generally based on students' VCE marks, called their ENTER score.

Swinburne University of Technology – Swinburne University was founded in 1992 although it has existed as an educational institution since 1908. Swinburne's operations are conducted at six campuses across Melbourne, catering for approximately 10,000 undergraduate and postgraduate students.

4. STUDENTS' RESPONSES

Students from five of the six institutions (CCSU, RIT, Kent, and Leeds, Ulster) were interviewed towards the end of the 2007/08 academic year. The Swinburne students were, however, interviewed over a two-year period, as part of a "Women in Computing" Research Project. Several papers have already been published related to this research [7, 8, 9, 10, 11, 12]; the interviews have been data-mined for responses.

4.1 Why Choose CS?

The students we interviewed were asked about their reasons for choosing a CS degree programme. Some mentioned favourable job prospects upon graduation:

- *My father is a programmer and both he and my mom, who is a Music teacher, encouraged me to look into computer science and programming more in-depth, since I enjoyed it and it would be a well paying career.* [US F]
- *Computers are an area where I believe there will be work in the future, as well as many opportunities to work for myself and to travel.* [UK M]

For others, their decision to pursue a CS degree was influenced by a strong role model:

- *My biggest influence is my brother. He's nine years older than me. He graduated from this university with a CS degree.* [US M]
- *My father is a programmer and encouraged me to pursue this field.* [US F]
- *I originally wanted to do psychology, but the A-level was boring. My boyfriend did Computing at the boys' school and it seemed interesting.* [UK F]

A number of students mentioned a significant exposure to Computing in their pre-university career, which had influenced their subject choice.

- *I have been taking computer-related classes every year in high school since the 7th grade.* [US M]
- *The reason was that I had a job doing Web design and really liked it.* [UK F]
- *I became interested in computers in middle school and high school.* [US F]

4.2 What Were You Expecting it to be Like?

Students were asked to think back to when they applied for and were about to start their degree programmes. We wanted to know what they were expecting when they walked into their first lectures and classes. Many weren't entirely sure what to expect:

- *I really had no idea whatsoever.* [US M]
- *I just wanted to do it, so I didn't think too much about what it would be like.* [UK F]
- *I guess I just thought it would be the same for all subjects, with lectures and stuff, only the content would be different.* [UK M]

Some students expected it to be interesting and mentally stimulating:

- *Interesting and learning new things!* [UK F]
- *Covering a wide dynamic of the cutting edge I.T industry* [UK F]

4.3 What is it Actually Like?

The majority of the students held a positive outlook towards their chosen degree programme. One female student commented that she liked the independence of university study, although another mentioned the high workload as a being problematic.

- *I thought it might be like the A-level, only harder. But there is actually even more stuff that I didn't even know about before.* [UK M]
- *There are loads more topics than I thought there would be. I can't wait to do the web module next year.* [UK F]
- *When I got here it wasn't as horrible as everyone made it seem.* [US F]
- *It has pretty much been what I expected.* [US F]
- *I didn't know there would be so much work ... it makes you think your brain is going to explode.* [UK F]
-

4.4 Were You Aware of the Gender Ratio?

The students were asked for their thoughts on the gender ratio within the CS student body; most had expected it to be a male-dominated demographic. The students said that they were not surprised that there were very few women in CS programs:

- *I had an idea because all of the high school classes that I took that were in CS there was one girl who was a friend of mine and like 20 or 30 guys.* [US M]

- *My expectations were that I would see a girl in a CS class every now and then.* [US F]
- *How would I know? I went to a girls' school in another country. It could have been all female and I wouldn't have known about it.* [UK F]
- *An area dominated by males.* [Aus F]

4.5 Is the Gender Ratio a Problem / Issue?

Whilst talking to the students we decided to find out what they thought about the gender ratio and whether or not they perceived it as a problem. Responses relate to both local day-to-day issues and the broader picture.

Local Issues:

- *I feel a bit under pressure in tutorials ... I think for me it's more of being one of the few girls in a tutorial full of confident boys.* [Aus F]
- *I sometimes feel like the guys in the back row are getting annoyed because I'm holding things up and they can't go and do complicated stuff, but then sometimes I'll hear one of them say "that's a good question" so I guess it's just in my head. Well I hope it is.* [UK F]
- *We want more girls to join in. If we see a new girl in the lecture room we make sure we go and talk to her and encourage her to stay.* [UK F]

Broader Picture:

- *I just think it never comes up – as you are growing up, guys play with blocks and the girls play with dolls. And it continues – for most girls, I guess, it just never comes to their mind to [even consider] being a CS major.* [US M]
- *Speaking from the women I know of – computers are scary and I don't know why.* [US F]
- *You see [women using computers] in the movies, you see it in the media – you see the men as the hacker, as the tech freak. You hardly see a woman doing that. When you see a woman doing it, it's more of a sexual connotation rather than – OK, that's normal, that a woman can fix a computer.* [US F]

4.6 Do You Have Any Suggestions?

Many students, regardless of gender, said that role models are extremely important. They focused on two kinds of role models: family and friends; current celebrities, business and political figures.

None of the students mentioned any historical role models. The female students all agreed that there is a lack of contemporary female role models to help them picture themselves as being successful in Computing. All students, regardless of gender suggest that stereotypes play an extremely important role; they unfortunately generally portray people in Computing in an unattractive light.

5. DISCUSSION

This work revisits and expands a 2001 UK-only investigation [4, 5] to include the USA and Australia. The results show that little has changed during the intervening seven years. They also suggest that the students from all three countries share very similar opinions. Overall student numbers have fallen and on top of this the proportion of female students has also decreased marginally. The students that we do attract, however, are still happy to be with us. It appears that similar issues are seen in all three countries represented here.

There are a number of fundamental differences between the ways students apply to study at university in our different countries. The UK and Australia have a similar application system whereby students apply to a university to study a specific program. Should the student subsequently decide they want to change direction and chose a different program they have to jump through many hoops and in most cases start again from the beginning, which is not a simple process. In the US however, students can often apply to an institution without identifying a specific program they intend to study. During the first year they can chose to study a variety of subjects and only decide on a 'major' at the beginning of year two. In spite of these differences, all three countries suffer the same problems with student recruitment and more specifically with recruiting females to study CS.

A common thread is the influence of parents and peers. This can be seen throughout all countries and is therefore something we can state as not unique to one nationality. The students we interviewed cited a range of role models who had a direct influence on the study and career path they chose. Parents have a great deal of influence and parents holding degrees in a science subject are particularly open to Computing as a good career choice; we need to target the parents as well as the students. Parents better appreciate the benefits of a professional, well paid career rather than a fashionable degree based on a whim.

Friend and sibling role models are much more difficult for us to influence, since teenagers often follow others rather than formulate their own opinions. School pupils making a decision about the degree program to study at a university are subject to significant influence from their peers. One useful strategy to combat this situation may be to involve current university students studying CS in the recruitment process. A university student from a CS program may appear much more believable and produce a significantly more positive impact if they were to appear at a school recruiting event.

6. WHAT NEXT?

One aspect missing from the questioning was that of career choice upon graduating. Much discussion about attracting more students is based upon obtaining undergraduate students, not about attracting students to the discipline. Perhaps we need to think a little more broadly about attracting a greater diversity of students – not just female – and attracting them to the world of Computing rather than just to our degree programs. Nobody undertakes a degree in dentistry for the sake of it – the degree is a route to the career they want to pursue. We need to stop thinking of a Computing degree as an end in itself and consider the discipline as a whole. Questions need to be posed to academics and computing professionals such as “What is a degree in computing?” The responses would be as varied as the individuals, however the historical baggage is that computing = programming, just as medicine = doctor; the most pervasive and difficult perception to influence.

7. ACKNOWLEDGMENTS

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PARTICIPATORY PATTERN IN ASYNCHRONOUS DISCUSSION FORUM: A CROSS-CULTURAL PERSPECTIVE

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ABSTRACT

In this paper, we demonstrate that students' cultural issues influence participation and engagement in online asynchronous discussions. We argue that student participation can be enhanced if discussion topics are carefully constructed taking into consideration the culture and local experiences gained by students in their country of origin. In order to elicit how cultural issues impact participation, a number of focus groups were created to study the participatory patterns of students. The observations of the study suggest conceptualisation of cultural factor elicits a set of constructs which can assist in formulating a discussion topic.

Keywords

Asynchronous discussions, online teaching, participatory patterns, cross-cultural issues.

1. INTRODUCTION

Asynchronous discussion forums have been used as learning and teaching tool in Education from as far as 1980s [1]. In the online environment, asynchronous group discussions have proven to enhance learning experiences [1, 2, 3]. However, it has also been observed that the successful engagement of learners in asynchronous discussion depends on a number of different cognitive indicators, such as, collaborative knowledge building by spontaneous interaction, and the ability of critical analysis. Collaborative knowledge building and achieving a high level of critical analysis through online discussion not only depend on the students' interest on the topic under discussion but also on factors that influence their pattern of participatory behaviour [4]. There is evidence that already certain investigative research has been carried out on various aspects of online asynchronous communication. For example in [5] the authors discuss various work carried out on participation, content, and structure of online conversations.

Despite the fact that research indicates many benefits of the effective use of discussion boards [6, 7] our experience shows that motivating students to participate still remains a challenge. One gap we have observed in the existing literature is the critical issue of arriving at the best structure for a given forum which will encourage participation. According to [8] participation in asynchronous discussion can be increased by increasing the level of motivation. This motivation is relative in nature and can be externally or internally driven. However, the authors do not indicate what these instigating factors are or provide any guidelines as to how we can arrive at them. This further substantiates the need for the study presented in this paper.

In [7], the Worcester Polytechnic Institute presents a set of guidelines which it considers to be good practice of how to improve the use of discussion boards. The website however, does not specify which is best for what purpose. So far we have not seen any literature which guides us through the quagmire of qualitative issues involved with using discussion forums to improve students' learning experience.

In this paper, we argue that, the participatory behaviour of students is largely influenced by the practices in their own country of origin, their national culture and their educational background. Middlesex is a multicultural university. In the School of Engineering and Information Sciences, sometimes almost 90% of the students at the postgraduate level are from overseas. This brings a rich cultural diversity to the classroom where students bring their own experience and different perceptions on a given topic. As Hopperton [1] states, this culturally diverse resource is not only useful in educational information, but also in eliciting the diverse approaches of the students. It offers challenges to the tutors. Cultural diversity needs to be an asset rather than a hindrance.

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So, how do we overcome the cultural barriers? As Markel [3] points out, '*What role does culture play in individual participation and communication styles?*'

Some research focus on the cultural issues in asynchronous discussion, for example, [9], but none has provided conclusive framework as to how cultural issues can be dealt with to enhance learning and teaching experience. Although, online learning is offered in many countries, and discussion forums are a common tool in almost every virtual learning environment (VLE), little research is carried out to demonstrate how cross-cultural issues can impact on the behaviour of participation in discussion forums. This paper will strive to ascertain the participatory pattern and online discussion behaviour of students from different cultures, and backgrounds in asynchronous discussions. The findings of this study will facilitate setting up discussion forums aimed to make the learning experience of all students richer irrespective of their cultures and backgrounds.

2. METHODOLOGY

In order to understand the determinants which enhance the participation of culturally diverse students, four focus groups (F1, F2, F3 and F4) were created. The purposes of these focus groups were to: i. monitor the behaviour in asynchronous discussion forum (F1 and F3); ii. receive continuous feedback from F1 on the design and implementation of the asynchronous discussion forum and to observe the participatory behaviour of F2 (See Table 1); and iii. observe participatory behaviour of the focus groups in a complete online teaching environment where classroom based teaching is not offered at all (F3 and F4). Table1 shows the composition of the focus groups.

Table 1: The composition of the Focus groups

| No. | Participants | Countries | Participatory Programmes | Participatory Institute and Teaching Method applied |
|-----|--------------|---|--|--|
| F1 | 15 nos. | Indian: 6; Srilanka:4; Kenya: 2; Ghana:1, Nigeria: 1; Pakistan:1 | M.Sc. in Business Information Technology (BIT) | School of Engineering and Information Sciences, Middlesex University. <u>Teaching Method:</u> Blended Approach |
| F2 | 20 nos. | Cyprus: 6; Egypt: 14 | MSc. In Business Information Technology (BIT) | Collaborative Partner Institute of Middlesex University, UK (i) University of Nicosia, 46, Makedonitissas Ave., P.O. Box 24005, 1700 Nicosia – Cyprus (ii) Regional IT Institute, 11-A Hassan Sabry St., Zamalek, Cairo, Egypt <u>Teaching Method:</u> Blended Approach |
| F3 | 9nos | UK: 1; Germany 2; Switzerland: 1; Netherland: 1; Timor-Leste: 1; Japan: 1; Iceland: 1, Canada: 1; | MSc. Information Technology (IT) | Liverpool University, in Partnership with Laureate Online Education. <u>Teaching Method:</u> Distance Learning and online teaching environment |
| F4 | 16nos | Ghana:1; Saudi Arabia: 2; Luxembourg: 1; Netherland: 2; Switzerland: 1; Nigeria: 2; Greece: 1; UK: 2; Qatar: 1; Rewanda: 1; Japan: 1, Uganda: 1 | MSc. Information Technology (IT) | Liverpool University, in Partnership with Laureate Online Education. <u>Teaching Method:</u> Distance Learning and online teaching environment |

Further to interviewing and observing the focus groups, a questionnaire based survey was conducted among 180 culturally diverse students. The aim of the survey was to find out the preferences for online discussion forum structure and preferred stimuli for engaging in online participation.

2.1 Experiment Design

To explore the cross-cultural affect on the students' participation we design a number of interlined activities which are described below.

A1: The aim was to explore the participatory patterns of the group. To understand the cross-cultural perspective, the focus of this activity was on a group of participants from the same cultural background, rather than the individuals. The duration of the activity was 4 weeks. The students received a topic of discussion

each week. The minimum requirement was to post an initial response to the discussion topic and at least one response to a peer. Participation to the discussion was made a part of the assessment criteria, although the participation itself was not evaluated. The aim was to observe the students participatory pattern when a minimum requirement is set for participation.

A2: Members of F1 were interviewed at the end of the participation period (four weeks) of A1. The focus of the interview was to find out the determinants of participation for different cross-cultural individuals. A questionnaire based survey was also carried out among 180 students to find out their preferences of participation to online discussion forum. The individual responses were then consolidated into cultural responses to understand a correlation between individual response and cultural preference.

A3: The online learning environment structure was revised based on the feedback from A2. The focus group F2 was asked to participate in online discussion using the new structure. The participation period was three weeks with two new discussion topics.

A4: The participation behaviour of F3 was observed. This focus group participated in the module where on ground class contacts were not required and only engaged in online discussion forum.

A5: Feedback from A2 and survey response from A3 were incorporated in the second run of the programme and applied to focus group F4.

3. OBSERVATIONS AND CONCEPTUALISATION OF PARTICIPATION PATTERN

We aim to demonstrate that determinants and stimuli influenced by cross cultural factors have better effects in online environments. In order to test the hypothesis we use our findings elicited from the five activities (A1-A5) described in Section 2.

Outcome of Activity 1 is presented in Table 2.

Table 2: Outcomes of Activity 1 (A1)

| Discussion topic type | Frequency of participation by nationality (at least in 50% cases) |
|--|--|
| Week1: Open discussion | India, Sri Lanka, Pakistan, Kenya, Rwanda, Ghana, China: Initial response, response to peer ranging from 1-2 Egypt, Cyprus, Nigeria: Initial response, a multiple response to peer ranging from 3-5 |
| Week2: Case study based problem and solution solicited | Pakistan, Rwanda, Kenya, China: Initial response, response to peer ranging from 1-2 India, Sri Lanka, Nigeria, Ghana, Egypt, Cyprus: Initial response, response to peer ranging from 3-5 |
| Week3: Case study based problem and solution is provided for discussion | China, Rwanda: Initial response and response to peer ranging from 1-2 Pakistan, India, Sri Lanka, Kenya, Nigeria, Ghana, Egypt, Cyprus: Initial response and response to peer ranging from 3-5 |
| Week4: Problem is given after the topic is introduced and discussed in the class. Solution is solicited. | China, Pakistan, Rwanda, India, Cyprus, Egypt, Sri Lanka, Nigeria, Ghana, Kenya: Initial response and response to peer ranging from 3-5. |

Observation (O1): Experience and background of the participants create an impact on the participation and engagement pattern in online discussion forums.

The individual selection of the discussion topic reflects the background experience and knowledge which a student has gained in his/her country of origin. Although discussion board participation was mandatory, since it was declared that this component will not be assessed it is assumed that the participation is partially spontaneous. Frequency of participation and the contents further confirmed this assumption.

In Activity 2 (A2), during the interview when the students were asked to select a discussion topic they preferred to be posted in online discussion forum out of 10 different types, the following were observed: Indian students preferred a topic where they expect a business case will be provided for analysis; Sri Lankan students preferred a topic where that provided a real life business scenario in which they can apply their previous experience; and Chinese students preferred a topic that focused on a specific problem. The overseas students did not show an interest in the type of questions where they have to formulate and identify a solution for a research question, whereas this type of discussion topic was selected by the local matured

students who had working experience. Chinese students specifically did not prefer to join in an open discussion.

Observation (O2): The preference for discussion topic is not same but similar for a specific culture.

The feedback from F1, e.g. preferences for discussion topic selection, was incorporated in constructing discussion topics and it was observed that the participation by the Cyprus and Egypt students (F2) were increased several folds.

When the students were asked what they expected from a discussion forum, Indian students reported that they prefer solutions to their problems to be provided in the discussion forum and very similar expectations were exhibited by the Pakistani and Nigerian students. Cypriot students on the other hand showed that they were interested in sharing views and to reach to a common agreement.

It was also observed that socialisation played an important role in engaging students in the discussion forum. When the international students were asked to join in an online chat folder it was observed that the students increased the level of participation in discussion forum significantly.

Observation (O3): Expectation from discussion forum varies from culture to culture.

The cultural implications were also evident in focus groups 3 and 4 (F3 and F4). When the participation pattern of F3 and F4 were analysed where the students only participated in mono-mode online distance learning environment, it was observed that participation frequency varies ranging from 4 posts (average) to 6 posts (average) in a week (it was confirmed that there were no personal issue reported to their Programme Support Managers) respectively. It was observed that the international students tend to participate less in online discussion forum compare to the local students if on ground classes are available. This is because they believed the contributions became publicly available to the peers and it also may elicit their level of understanding on a concept.

Observation (O4): Local working environment and national competency influence significantly on engaging in online discussion.

Different types of discussion topic were selected for F4 to engage them in online discussion forum. It was observed that the discussion topics that matched with the international participants' previous working experiences were selected mostly for further discussion in online forum. It was also observed that a large group of international students preferred the discussion topics which included the working environment setting of the students' own country of origin, i.e. title, terms, activity flow for case study, and the local knowledge base, i.e. numeracy or literacy skill, for further discussion in online forum.

It was also evident from the survey that less familiarity to online learning environment, tools and their formats also affected students' performance in online discussion participation.

Based on the observations a conceptualization of the cross-cultural factors which influence the participatory pattern is proposed in Figure 1.

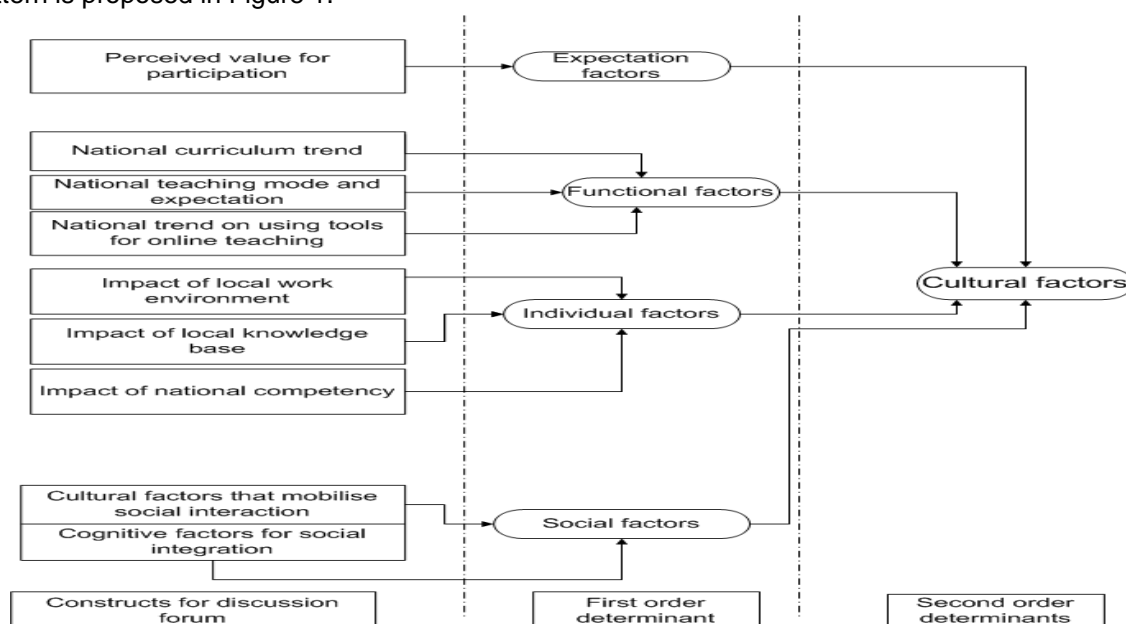


Figure 1: Cultural factors to determine constructs for discussion.

4. CONCLUSION

This paper demonstrates that students' participation pattern and their engagement in asynchronous discussion varies due to their preferences and enthusiasm on the discussion topic. It is evident from the study that these preferences are dominated mostly by their cultural background which includes social, individual, functional and expectation factors. Based on our observations we propose conceptualising these factors and attempt to derive a set of constructs which can assist in designing an engaging discussion topic. These constructs will enable the e-learning facilitators to enhance the engagement of the culturally diverse students in asynchronous discussion forum.

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INVESTIGATING THE USE OF PODCASTS TO SUPPORT BASIC AND INTERMEDIARY SKILLS DEVELOPMENT, IN EXCEL, AT UNDERGRADUATE AND FOUNDATION LEVELS

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ABSTRACT

Audio or video podcasts can offer students different ways of learning and can add value by providing access to learning materials 'on the move'. This paper presents an initial investigation into the use of excel podcasts for undergraduate and foundation level students in different faculties at a single university. The podcasts were shown in lecture and seminar settings and uploaded to an online server for all students to access in their own time; either via a web browser or portable video player such as an iPod.

Results for the on-going study were positive with the majority of students using them for developing their understanding of excel and exam revision. Students expressed an interest in having similar supplementary learning materials for other modules. Such conclusions drawn from this study highlight the need to investigate the use of podcasts further in the teaching and learning environment.

Keywords

Podcast, screencast, educational multimedia, iPod, mobile media player

1. INTRODUCTION

As part of the CETL ALiC (Centre for Excellence in Teaching and Learning: Active Learning in Computing) initiative this paper discusses one of many projects being conducted across Leeds Metropolitan University within the area of technology enhanced learning. CETL ALiC is a collaborative HEFCE funded project between the universities of Durham, Leeds Metropolitan, Leeds and Newcastle [1].

In this paper we will discuss findings from an on-going investigation into the use of podcasts as supplementary learning materials to support students in their development. 'Podcasts' are digital audio or video files that can be played on a computer or downloaded to a portable player, such as an iPod [2]. Podcasts have the benefit of being continuously available and can be used flexibly by the learner, either via mobile or fixed technologies, which may enhance both learning and motivation [3].

Podcasts can be implemented as reusable learning objects to explain concepts to students. They have the advantage that the podcasts can be viewed repeatedly by students to aid understanding and for revision purposes [4]. They can also be beneficial for teaching staff as they can be reused for different student cohorts and for distance learning students. In addition, research [5] has demonstrated the potential that podcasts can offer to students for whom English is the second language.

2. BACKGROUND

In the academic year 2008/09, we introduced a series of podcasts to students studying on modules that covered Microsoft Excel skills as part of their course content. The modules were based in three different faculties at Leeds Metropolitan University at different levels of study.

Each module was a one semester taught module:

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1. Module A: Foundation level, i.e. on a pre-university course (approximately 130 students)
2. Module B: Undergraduate Level 1, HND (approximately 180 students)
3. Module C: Undergraduate Level 1 BA (Hons) (approximately 470 students)

[780 total student numbers; not accounting for non-attenders]

Modules A and B were taught exclusively in computer labs, Module C was taught in computer labs and lecture theatres. The short video clips, or podcasts, were developed specifically for students with varying levels of Microsoft Excel experience from basic through to intermediary level. The podcasts were designed to support the learners in acquiring, developing and maintaining excel skills.

We produced a series of ten podcasts to explain basic elements of excel, such as naming sheets and inserting columns/rows, through to excel functions such as SUM and VLOOKUP - see Figure 1. The podcasts varied from one to six minutes in length to not exceed the attention span of the listener. Module A was designed as an introductory course to excel whereas Modules B and C covered more advanced functions. Hence a subset of podcasts was used for Module A with an additional podcast based on creating charts. All ten podcasts were used for Modules B and C.

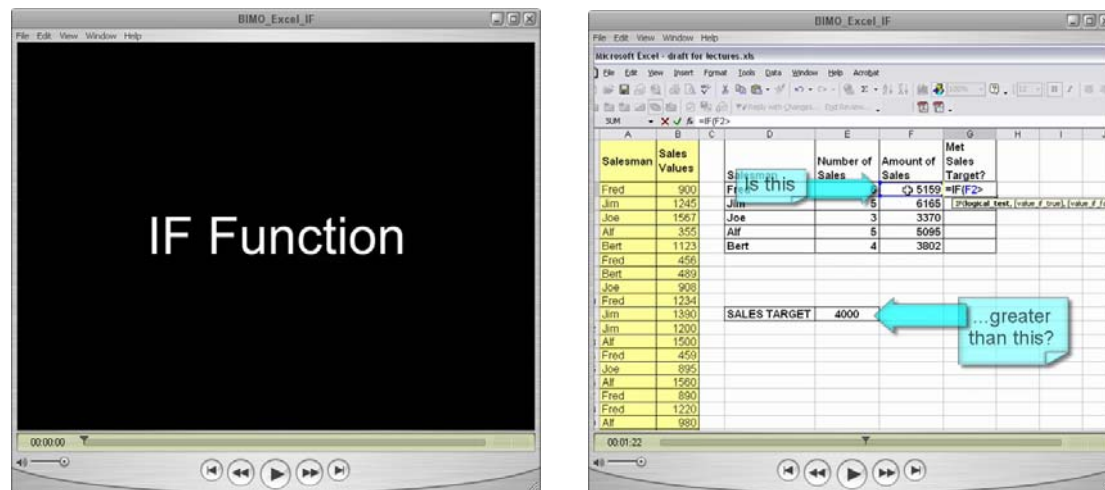


Figure 1: an example screen shot of one of the excel podcasts (IF function)

2.1 Development and delivery of podcasts

The podcasts were produced using screen video capture software¹ which allowed the recording of on screen movements and voice over. This footage was then exported to an 'editing studio' in a chosen file format, such as MP4 or MOV, edited and then finally saved as video files. These short video tutorials were then made available via the university's virtual learning environment (Blackboard Vista). The podcasts could be viewed directly through a web browser or downloaded to the computer's hard drive. In addition, the files were uploaded to the university's podcast server, which enabled students to subscribe to the podcasts via RSS feeds and RSS readers such as Apple iTunes. This meant that once a student had subscribed to the podcast series, new episodes of the podcasts would be automatically downloaded to the student's computer via the iTunes software and could then be automatically transferred to their mobile multimedia player.

The podcasts were shown to the students in the lab sessions (Module A and B) and lectures (Module C), and the students were encouraged to view them again in their own time.

¹ We used Camtasia Studio (<http://www.techsmith.com/camtasia.asp>) but free open source software is also available, such as <http://camstudio.org/>

Members of staff teaching on the modules used the podcasts in different ways; some offered the podcasts as supplementary materials to be viewed in addition to the course material, whereas the majority of staff used them to demonstrate excel concepts within the class environment.

3. DATA COLLECTION AND RESULTS

Shortly after the students had completed the excel section of the module, they were encouraged to complete a short online survey (ten questions) or module evaluation survey to gather their views about the podcasts. Information was sought on issues such as how useful the students found the podcasts and whether they accessed the podcasts outside university. Ethical approval had already been confirmed via the university ethics committee.

Data was collected from Module A and Module C at similar points in the academic calendar. The data collected was analysed and as a result additional questions were added to the survey for Module B in order to collect richer data, such as in what ways they used the podcasts, i.e. as a reminder or for development of skills. Response rates to the surveys were as follows: Module A (53 out of 130 students) 41% return rate; Module B (66 out of 180 students) 37% return rate; Module C (86 out of 470 students) 18% return rate.

3.1 MODULE A (Foundation Level)

From the results collected for Module A, 64% of the respondents stated that the podcasts were 'useful' or 'very useful'. 56% of the respondents said that they would like to have similar podcasts in other modules.

Having been shown the podcasts in the classes 44.5% of the respondents went on to view them again in their own time either at home or on university campus. Figure 2 shows the number of times that the excel podcasts were viewed by the students on the module. The podcasts were accessed a total number of 159 times with 'getting started' viewed the most (58 times).

| Excel podcast episode | Visits | Length of podcast (minutes) |
|-----------------------|------------|-----------------------------|
| Getting started | 58 | 01:36 |
| AutoFill Insert Col | 41 | 01:08 |
| Creating charts | 35 | 03:19 |
| Dates Times | 25 | 01:58 |
| <i>TOTAL</i> | <i>159</i> | |

Figure 2: Usage statistics for excel podcasts Module A

3.2 MODULE B (Undergraduate Level 1 HND)

Responses to the evaluation for Module B showed that 79% thought the podcasts were 'fairly' or 'very easy' to view. However, outside of the lessons, only 1.5% viewed them on their iPod as stated in the questionnaire. 44% of the sample had viewed them again on their home PC, 15% of the sample had revisited them on a campus computer and 45.5% of the respondents had not viewed them again outside of the lesson.

With regard to how the podcasts were used, 74% found that they aided their understanding of the information better, and 26% used them if they happened to miss the lecture or tutorial. A high proportion of students, 83%, said that they would like to have similar podcasts for other modules.

The podcasts were accessed a total of 544 times by the students on Module B. Figure 3 shows a breakdown of the number of visits per episode, as well as the length of each podcast. It is worthy of note that the 'Getting started' podcast received the most number of hits (136).

| Excel podcast episode | Visits | Length of podcast (minutes) |
|--------------------------------|------------|-----------------------------|
| Getting started | 136 | 01:36 |
| Updating Formula Results | 70 | 01:24 |
| Dates Times | 62 | 01:58 |
| Auto Fill with Cell References | 46 | 02:40 |
| Auto Fill 4 Formulas | 45 | 02:32 |
| COUNT IF Function | 44 | 01:51 |
| VLOOKUP | 43 | 05:28 |
| IF Function | 37 | 02:41 |
| Creating Charts | 29 | 03:19 |
| SUM IF | 25 | 01:59 |
| AutoFill Insert Col | 7 | 01:08 |
| <i>Total</i> | <i>544</i> | |

Figure 3: Usage statistics for excel podcasts Module B

3.3 MODULE C (Undergraduate Level 1 BA (Hons))

Of those students who responded to the evaluation for Module C, 23% made the extra effort to provide further written feedback stating that the excel component and how it was delivered was one of the elements of the module that they had enjoyed the most.

Usage statistics for Module C showed that the podcasts were accessed a total number of 871 times during the module, November 2008 to January 2009 - see Figure 4 for breakdown. In line with the other two modules (A and B), the 'Getting started' podcast was viewed the most times (198). Out of the total number of viewings, 673 hits (77%) occurred the week leading up to the module exam demonstrating the popularity of the podcasts for revision purposes. In addition the podcasts were viewed 15 times the week before the reassessment module exam which was sat by 20 students.

| Excel podcast episode | Visits | Length of podcast (minutes) |
|--------------------------------|------------|-----------------------------|
| Getting started | 198 | 01:36 |
| Dates Times | 101 | 01:58 |
| COUNT IF Function | 93 | 01:51 |
| Updating Formula Results | 91 | 01:24 |
| Auto Fill 4 Formulas | 83 | 02:32 |
| AutoFill Insert Col | 74 | 01:08 |
| IF Function | 60 | 02:41 |
| VLOOKUP | 59 | 05:28 |
| SUM IF | 58 | 01:59 |
| Auto Fill with Cell References | 54 | 02:40 |
| <i>Total</i> | <i>544</i> | |

Figure 4: Accessing excel podcasts for Module C (November 2008 - January 2009)

Teaching staff from all three modules teams reported positively towards the podcasts as a teaching resource. In addition, they stated that their students commented that they liked watching the podcasts and found them useful and relevant.

4. CONCLUSION AND FURTHER RESEARCH

Results gained from our initial investigation were positive towards the use of podcasts for excel teaching. The students on the whole spoke favourably about the short video clips in the survey responses and in addition spoke with enthusiasm to the teaching staff on the modules.

A significant outcome for the research team was the demand for similar podcasts for other modules from each of the student cohorts surveyed. Additional use of the podcasts, outside of the classes, varied from revision to developing knowledge of the skills required. The podcasts for Module C were accessed the most in the week preceding the final module exam indicating their popularity for revision purposes. The usefulness of podcasts for exam preparation has also been found by other studies (see for example [5], [6]).

With regard to viewing the podcasts in their own time, only 1.5% of the students in one module (Module B) downloaded podcasts to a portable device. However as this was not explicitly mentioned by most staff teaching on the modules, this figure is not surprising. Other studies, such as [7] also found that podcasting does not equate to learning via mobile devices, even though podcasting technology supports the possibility of mobile learning. Further research on this will be undertaken.

Although we did not look specifically at the use of the podcasts by international students; Module A was delivered solely to international students and hence we can draw some positives from this resource for non-native English speakers. Research in other case studies at our university strengthens this finding in that podcasts were particularly perceived to be useful as they allowed re-listening to the learning materials and provided further support in learning the language [8].

With an emphasis on demand by the students for similar podcasts in other modules the need to investigate the use of podcasts further in the teaching and learning environment is warranted. We are currently in the process of producing more podcasts for additional modules in order to conduct further evaluation with a focus on potential benefits for international students. In addition we are planning to investigate student preferences with regard to accessing podcasts, such as via a web browser or mobile device.

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CREATING EDUCATIONAL IMMERSIVE ENVIRONMENTS USING A COMPUTER GAME ENGINE: CASE STUDIES AND DESIGN THEORY.

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ABSTRACT

This paper aims to crystallize recent research performed at the University of Worcester to investigate the feasibility of using the commercial game engine 'Unreal Tournament 2004' (UT2004) to produce 'Educational Immersive Environments' (EIEs) suitable for education and training. Our research has been supported by the UK Higher Education Academy. We discuss both practical and theoretical aspects of EIEs. The practical aspects include the production of EIEs to support high school physics education, the education of architects, and the learning of literacy by primary school children. This research is based on the development of our novel instructional medium, 'UnrealPowerPoint'. Our fundamental guiding principles are that, first, pedagogy must inform technology, and second, that both teachers and pupils should be empowered to produce educational materials. Our work is informed by current educational theories such as constructivism, experiential learning and socio-cultural approaches as well as elements of instructional design and game principles.

Keywords

Serious games. Physics Education, Architecture Education, Primary Literacy, Learning Theories, Unreal Tournament 2004.

1. INTRODUCTION

This century has witnessed the emergence of a digital culture of gaming [1], which has dramatically changed the way in which children play and learn. If learning is to be effective, then it should be congruent to this digital culture [2]. It has been suggested that most present day learners can be described as 'engage me or enrage me', who challenge the nature of contemporary education [3]. Such a view of education is seen as one factor contributing to the decline in interest in science and engineering studies. [4,5]. The use of computer games in education is believed to be an approach which will re-engage our learners and re-invigorate learning situations [6,7,8]. While initial research suggests that computer games can improve acquisition of cognitive abilities and learner understanding [9,10], this research is preliminary. There is currently little hard evidence that computer games actually work in education, and there is also a lack of understanding of how serious games should be designed and used to obtain effective learning. A first step to address these issues is to work with schools and teachers to produce *demonstrator* EIEs which are informed by educational theory and classroom practice. At Worcester we have developed materials for physics education in UK secondary schools, materials for UK primary school literacy teaching and materials suitable for the training of architects. These applications are extensions of a generic framework which has emerged from our work on 'UnrealPowerPoint' a new instructional medium which liberates the instructor from a sequential mode of instruction.

This paper is structured as follows: In Section 2 we discuss examples of EIEs based upon the UT2004 technology. Section 3 summarises a preliminary theoretical basis for our approach to design. Conclusions from our research and directions of future research and development are indicated in Section 4. We have been guided by many principles; perhaps the most important is encapsulated in our motto 'from pedagogy to technology'. Here we suggest that the development of any new educational technology should be driven by pedagogy, educational theories, instructional and game design principles, but also by collaborating with teacher-practitioners in the development process. In the design phase of EIEs, these factors are mapped onto the affordances of the computer game technology.

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2. CREATING EDUCATIONAL IMMERSIVE ENVIRONMENTS

A typical EIE aimed at physics education is depicted in Figure 1. This example captures several important elements. The learner, the girl, is immersed in a world where physics is faithfully reproduced. Other learners may enter this world on-line (equipped with headsets), and so collaborate in a learning activity. The EIE also contains 'non-player characters' (NPCs), the boys, whose behaviour is programmed to dynamically interact with the learner, to provide help, guidance or to engage in discourse, i.e., they are artificially intelligent.

2.1 UnrealPowerPoint: A new instructional medium

There are many ways to characterise learning, as a neurophysiological process, as a social activity or directed by the curriculum defined by government policy. Within this arena, cognitive science provides a middle ground, the theory of 'knowledge structures'. This theory attempts to capture the way concepts known to the expert can be assimilated by the novice learner. Learning is a process of transformation from the sophisticated knowledge structures of the expert, into the developing structures of the learner. We employ 'concept maps', graphical devices proposed by Novak which display a hierarchy of concepts for a particular domain, linked by relationships between these concepts. A concept map distilled from the expert can define the EIE topology, specifying which rooms (concepts), are connected to other rooms by passageways (relationships). We have used this theory to devise the 'UnrealPowerPoint' presentational technology. Here, various concepts introduced as PowerPoint slides are embedded in a 3D world, each concept located in a different room or place within the world. As the learners walk through this world, they are effectively traversing the concept map of the expert. The medium is 'nonlinear', allowing the instructor to select a path through learning materials based on the real-time state of the students as they respond within the lecture theatre [11].

2.2 Physics Education

There is an emerging feeling within educationalists that physics education is in a state of crisis [12]. This is shown by a falling recruitment in A-level and University courses, and a shortage of specialist physics school teachers. This issue has been addressed by the Institute of Physics [13], and their recommendations have motivated our construction of EIEs intended to rejuvenate interest in physics as a domain of study, and also of scientific progression as a collaborative activity. Our proposal is that EIEs can provide a useful domain of physics education, supported by sound pedagogical principles and by the high-fidelity UT2004 physics engine component realizing a metaphor of true scientific enquiry. Our research has moved through several phases. First we constructed various *qualitative* experimental EIEs where students were able to make observations (e.g., of simple harmonic motion), to change parameters, and to reflect on the consequences. Measurements of 'attitude' indicate a positive impact of our approach [14]. Second we have conducted an in-depth numerical investigation into the *fidelity* of the UT2004 physics engine to reproduce virtual experimental results in accordance with physics theory [15]. These investigations have been positive, although there are some caveats. Third, as a result of this research, we have designed and developed educational resources suitable for senior high-school classes [16]. We have also identified several strategies for the deployment of physics instructional materials. These comprise (i) teacher-based, (ii) learning by enquiry, (iii) becoming a 'scientist for a day'. In the latter strategy, pupils are taught how to construct EIEs and so are able to devise and investigate their own experiments.

2.3 Architecture Education

Through a study of architecture, and with the help of teaching architecture to second-year undergraduate games-development students, we have identified various concepts and principles of architecture and have mapped these onto the affordances of the UT2004 game engine. Unwin gives insight into architectural concepts [17], which can be taken together as a definition of architecture: (i) An intellectual structure. (ii) Places are defined by function. (iii) There exists a 'language' of place. (iv) 'Place' is continually re-defined by its inhabitants. (v) Inhabitants' beliefs and desires must be taken on board. These concepts can be realized in an EIE, first, through appropriate topological design, points (i) to (iii). Also, through the use of 'non-player characters' (NPCs), points (iv) and (v). Coding NPCs to move within and between buildings is useful to architects, since it provides a realistic visualization of 'circulation' of people within the architectural space. Students working in a level-5 game development module at Worcester studied architecture over a period of 4 weeks and were then able to craft realistic EIEs. Figure 2 shows an example of circulation where NPCs have been coded to move around a series of paths, where their circulation is based upon individual interactions.

Through extensive consultation with teachers at a local primary school, which involved an initial demonstration of an EIE, it was decided to adopt the classroom approach of 'VCOP' (Vocabulary, Connectives, Openers and Punctuation) where each of these elements of literacy is highlighted and discussed. These four elements were complemented by the 'Library' and the 'Big Writing Room' which reflects a particular classroom activity which

takes place as a synoptic activity at the end of the week. The resulting topological structure is shown in Fig.3. This structure was realised as a 'Roman Villa' (Fig.4) which contained a high number of interactive elements. Details of this research are available in [18].

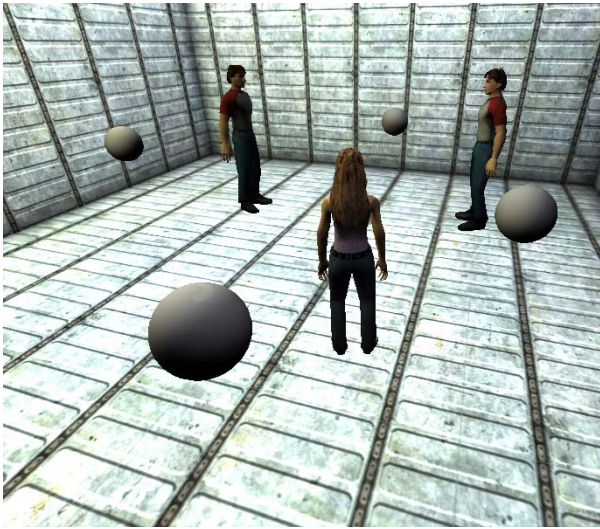


Figure 1. A typical IE used in physics education. The player (girl) is engaged in dialogue with the NPCs (boys) about a physics experiment, concerning the motion of objects in a gravitational field.



Figure 2. Example of circulation in architecture. The three boys have been programmed to move along set paths, but must deal collectively with any interactions.

2.4 Primary Literacy Education

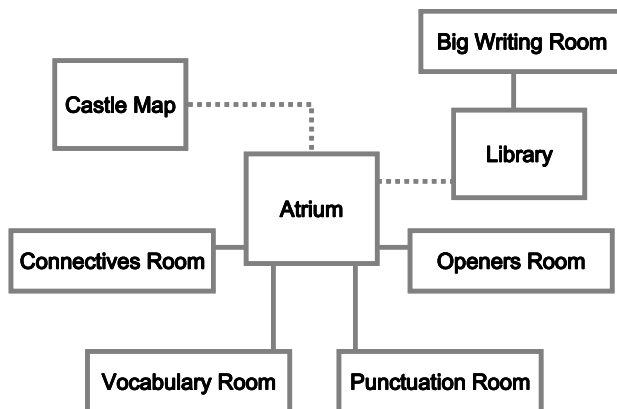


Figure 3. The *topological structure* of the Primary Literacy EIE showing central atrium, 'VCOP' rooms the Library and the 'Big Writing' room. The 'Castle Map' was an area devoted to



Figure 4. This screenshot shows part of the realization of the topology (Fig.3) using UT2004. It shows the central atrium and gives an indication of textures and objects in

This EIE was deployed in the local primary school and was evaluated through formal observations of 11 pairs of pupils. The main conclusions from these observations are (i) Pupils were highly engaged with this EIE and were motivated to use it in their free time. (ii) There was often a lack of efficient *information flow* where pupils did not read instructions or listen to instructions spoken by the NPCs. (iii) The separation of the 'fun' area, the 'Castle' map from the primary VCOP learning areas was not ideal. (iv) The EIE's structure was configured by the teacher according to a specified lesson plan. This could perhaps be relaxed, allowing pupils to choose their own learning pathways. Nevertheless, the EIE remains in the school and is being further investigated as a learning resource.

3. ESTABLISHING A THEORY OF EDUCATIONAL IES

The literature around 'serious games' has yet to come to terms with establishing a pedagogical theoretical basis for the design of EIEs. We have attempted to address this deficiency in our research. There are many issues thrown up by both contemporary thinking in education and also by the technological affordances of computer game engines. Our guiding principle of 'from pedagogy to technology' attempts to equilibrate these tensions. As discussed below, we have identified several fundamental issues: (i) The nature of learning, from a cognitive perspective. Here we mean both the acquisition of knowledge as a structure by the human mind, and also the dynamic process of learning. (ii) The nature of *collaborative* learning according to constructivist and socio-cultural theories. (iii) Adaptive learning, a neo-computer aided instruction paradigm. This can be contrasted with the computer game design principles. Designers tend to work intuitively and focus largely on 'game play rules' without consideration of effective learning.

THE SPATIAL METAPHOR. In our age of pervasive computing and the assertion of 'computational thinking' as a new epistemology, we cannot forgo our circumstantial culture [19]. One middle-ground is to draw on cognitive science, the discipline which attempts to establish a conversation between the machine and the human. Within this theory, the concept of 'knowledge structures' has been advanced to capture the nature of human knowledge representation and of thinking. Realized as 'concept maps' [20] such structures capture the understanding of both novice and expert, and suggest that learning involves a *transformation* from the one to the other [21]. Our research into the use of EIEs invokes the *spatial metaphor*. We suggest that EIEs (rooms, textures and objects) should be constructed as a homeomorphism of the knowledge structure of the expert. The EIE rooms are identified with concepts; the communicating passageways are identified with interactions or relationships between concepts. As the learners move through the EIE rooms, they are effectively traversing the knowledge structures of the expert.

LEARNING DYNAMICS. Learning is a dynamic activity. It is a process, not a procedure. Piaget sees learning as a 'middle ground' between activity and thinking, a structured system in equilibrium. The 'Experiential Learning Theory' of Kolb [22] is also situated in this middle ground. We have instantiated Kolb's four-stage cycle of concrete experience, reflective observation, abstract conceptualization and active experimentation as a 'cluster' of rooms within an EIE centered on a particular concept. Students entering a 'Kolb cluster' are presented with materials and activities to address each stage of the whole cycle.

COLLABORATIVE LEARNING. A multi-player EIE as realized by a game engine such as UT2004 is pregnant with technical opportunities for collaboration. Learners, equipped with headsets and microphones, may enter an EIE via their avatars and communicate with voice or text in the first order. Collaboration implies a common *context*, some problem or issue to be resolved, and a motivation to collaborate. But most fundamental is the channel of communication, and within this channel lies conversation, which can be factored as: (i) Narrative, (ii) Discourse, (iii) Dialogue, [23].

ADAPTIVE LEARNING. There has been a renewed interest in learning environments that adapt to the state of the learner [24]. A good classification of adaptive methodologies has been proposed by Burgos and Specht [25]. We have constructed EIEs which are adaptive in their presentation of materials and activities to the learner. In one example, the EIE space is extended according to a run-time assessment of the learner, via tests or via monitoring their engagement with learning activities. This assessment is used to open up additional remedial or extension rooms.

4. CONCLUSIONS AND FUTURE WORK

Our work has been disseminated in various contexts. UnrealPowerPoint has been used for three conference presentations and other informal events. The physics materials have been trialled, on a small scale, with local school children. The approach to architecture has been evaluated through discussion with a number of architecture bureaux. The primary school EIE has been evaluated through observations of pupil activity within a local Primary School. The next phase of our work involves a large scale scientific study of our EIEs which aims to evaluate the learning efficacy of our materials as well as the learners' attitudes towards these. In addition, new areas of research have been identified. These include (i) the use of EIEs to provide art galleries or art installations, (ii) the design of EIEs for business simulations, (iii) the use of EIEs to explore the learning of music.

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PERSONALISED FEEDBACK WITH SEMI-AUTOMATIC ASSESSMENT TOOL FOR CONCEPTUAL DATABASE MODEL

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ABSTRACT

The increased presence of diagram-type student work in higher education has recently attracted researchers to look into the automation of diagram marking. This paper introduces web-based diagram drawing and marking tools for a new (semi-automatic) assessment approach. The approach reduces the number of diagram components marked by the human marker and provides individualised and detailed feedback to students. The tools which have been used in tutorials of a first year database module in the Computer Science department at Loughborough University are described together with findings from the usage of the tools.

Keywords

Conceptual Database Diagram, Diagram-Type Student Work, Improving Assessment and Student Feedback

1. INTRODUCTION

Feedback is an important part of formative assessment. It makes learners aware of any gaps that exist between their desired goal and their current knowledge, understanding, or skill [9]. Feedback on tests and homework is most useful when it provides specific suggestions for improvement [4]. Nicol and Macfarlane in their paper [8] presented a conceptual model of formative assessment & feedback and the seven principles of good feedback practice. Although feedback is widely accepted as a crucial part in the learning for assessment, in higher education, Gibbs and Simpson [5] argue that feedback to individual students in a class must have declined significantly as class sizes have increased.

Various systems have been developed to automatically mark student work and generate feedback. However there are very limited proven forms of automated assessment (e.g. multiple-choice, matching questions or simple 'fill in the blank' questions). These forms of automated assessment are not sophisticated enough to examine a student's understanding of complex content and thinking patterns [7]. Diagram-type student work (e.g. ER diagrams, UML) can be used to assess a student's knowledge in a more comprehensive way, as can essay-type student answers. Although there is some research into automatic essay and diagram marking (e.g. DEAP Project [11]), full automation of marking hasn't been achieved yet. We believe that human markers are still required to manually assess the diagrams in a supportive online environment. This environment can be seen as an intermediate stage for the future fully automatic systems.

We have developed a semi-automatic assessment system with the main characteristics of online diagram drawing and online marking of these diagrams by a human marker using a specialised tool. Based on this core system we have also developed an interactive environment that allows students to access detailed personalised feedback. Among hundreds of known diagrammatic notations in computer science, the research, in its initial stage, focuses on conceptual database diagrams (Entity Relationship diagrams).

The aim of the marking tool is to reduce the number of the components in the diagrams marked by the examiner, which is called semi-automatic marking in our research. That requires finding the identical components in different student diagrams. The Assess By Computer (ABC) [12] project, which has the same aim as this project, defines identical components by using those component's attributes (e.g. label, type, adjacent boxes). In our research, identical components are defined by the references to the text describing the scenario (scenario referencing). A similar approach is used for the intelligent tutoring system in KERMIT [10]

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and ERM-VLE [10] projects. Scenario referencing and component matching are discussed in the Semi-automatic assessment section.

The KERMIT and ERM-VLE projects have developed their own online diagram editors to capture student diagrams. This research also requires its own diagram editor. The editor and marking tool are improved versions over those reported previously [6]. Discussion of the changes to the tools and the results obtained are presented below.

2. SEMI-AUTOMATIC ASSESSMENT

The semi-automatic marking aims to reduce the number of diagrams marked by the assessor. The system groups identical segments of the students' diagrams and then asks the assessor to approve the correctness of a diagram fragment from each of the different groups. Therefore the assessor would be involved in the marking process only for the number of diagram groups rather than the total number of student diagrams.

The correctness of the grouping depends on the criteria used to match the diagram pieces. The smallest diagram piece in each group can be either an entity or relationship component for a conceptual database diagram. This research uses the student design traces as criteria for each component in their diagram. Design traces are links from scenario texts to diagram components. So, for example, 'Lecturer' and 'HoD' might appear in a scenario and be initially mapped to corresponding entities which may at a later stage be merged into a 'Staff' entity. Thus there is a trace which links 'Lecturer' in the scenario to the entity 'Staff' in the diagram. Components of student diagrams for the same scenario are grouped based on these links in the semi-automatic approach. One component from each component group is represented with its design trace to the examiner. The examiners can see how the student created the components. It may enable the examiner to understand more and comment on the student's work.

The central part of the approach is the process of grouping diagram components. Too many component groups to be marked could decrease the efficiency of the assessment process severely. The number of groups depends on the number of different references for a particular component. The reason for different references is diversity in either the students' reasoning or their action for the same reasoning. The reasoning diversity is restricted by the given scenario text. The action diversity is limited by the user interface of the diagram editor. A method for scenario text writing was developed to control the reasoning diversity. The details of the method can be found in [2].

The marking part of the approach cannot change the number of component groups. However, some groups could be marked automatically if the ideal diagrams and previously marked components of a scenario are available. Automatic marking requires domain independent rules. The rules could be produced gradually after analysing the previously marked components for various scenarios. Each new rule generated will increase the efficiency of the system. Some example rules are explained in the marking tool section.

3. DIAGRAMMING TOOL

A special diagram editor was developed for the production of the design traces. The editor alters the traditional diagramming process in order to ease the trace production. The student doesn't draw a diagram for their design. They simply enter their component type and name and then the tool draws the student diagram. In this way, they can focus more on designing than drawing. The alteration enables students to follow the steps of the conceptual database design methodology taught in the database module.

The user interface of the editor is shown in Figure 1. It has four panes; Scenario, Tool bar, Diagram and General command. The Scenario pane shows the scenario paragraph by paragraph so that the student considers the information in that section only. This method is called "Scenario scaffolding" [3]. The scaffolding has a potential to reduce the action diversity. The Tool bar is used for creating components in the diagram pane. The Diagram pane automatically draws a diagram for a student design. General command panes are used for additional activities like submitting a diagram and displaying a diagram in UML notation.

Figure 1 shows an entity creation action as an example. To create a new entity type (or attribute) the student drags a noun-phrase directly from the scenario text in the current section and drops it onto the entity box in the tool bar and the new entity component is added to the diagram. In this way, a direct reference to the entity is captured. To create a relationship type, the student drags two noun-phrases and drops them onto the appropriate boxes in the bar. Then, in a pop-up dialog, the cardinality, optionality and name of the relationship are entered by the student. The direct reference of the relationship is deduced from the position of the two phrases in the scenario.

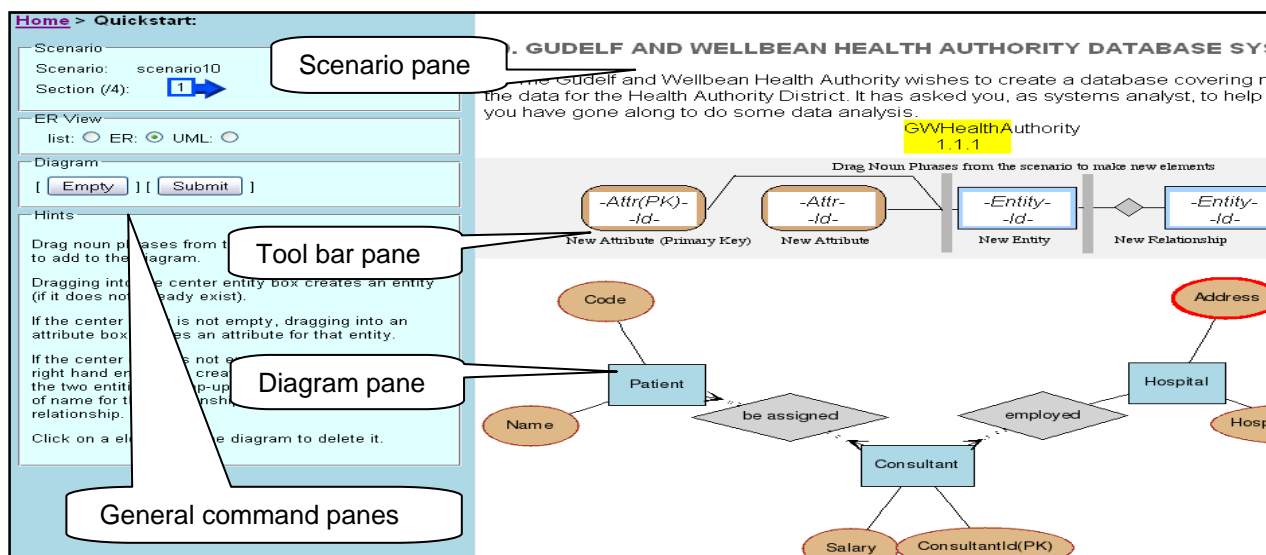


Figure 1 User interface of the diagramming tool

Scenarios used in the tutorials for this semester do not require creation of indirectly referenced components. The next version of the tool is already available which supports creating all types of components. However it has not been used in the tutorials yet.

4. MARKING TOOL

The marking tool is designed mainly to ease the partial marking style which enables semi-automatic assessment. It also needs to support the complete marking style which imitates paper-based marking. The details of complete marking can be found in [1]. Before the examiner marks diagram components partially, the engine part of the tool processes student diagrams in three phases; Normalisation, Grouping and Automatic marking.

Properties of diagram components used as matching criteria are put into a standard form in the normalisation phase to decrease the number of component groups. For example, Student S1 has got a relationship Rs1 between Entities E1 and E2 with a direct reference Ref1 which is represented as Rs1(E1,E2,Ref1). Student S2 has got a relationship Rs2(E2,E1,Ref1). After normalisation, Rs2 is written in Rs2(E1,E2,Ref1) so that Rs1 and Rs2 are in the same group. The second phase is to group components by using matching criteria. The criteria of a direct referenced entity is a noun phrase reference (e.g. Es1 (Ref2)). For each attribute, the criteria are their noun phrase reference and related entity (e.g. As1(E1,Ref3)). For relationships a sentence reference is used with the participating entities (e.g. Rs1(E1,E2,Ref1)).

Third phase marks some components automatically. The basic rule is to use the examiner's ideal diagram. If one of the group components belongs to the ideal diagram, all the other members become correct (e.g. Gcorrect(Rs1,Rs2,Rs3,Rteacher)). If many students get components correct then the automation will be increased. Another rule is to use previously marked components. If an entity is wrong, all attribute and relationship components related to that entity become wrong (e.g. As1wrong(E1wrong,Ref3) or Rs1wrong(E1wrong,E2,Ref1)). If the wrong entity is a common mistake, many diagram components are marked automatically and this increases the efficiency of the system. Figure 2a shows the command pane of the editor. "Prepare" command does the normalisation and grouping. "Mark by" and "Pre-Rel" command do the automatic marking.

Figure 2b shows the interface of the partial marking editor. The tool displays the unmarked components to the examiner. The examiner first sees all entity components, then attribute and finally relationship components. If the component is an entity type then only its noun phrase reference is displayed. If it is an attribute then its noun phrase reference and entity is shown. If it is a relationship, then its reference sentence and participant entities are presented. Components are marked as correct, accept or incorrect. The examiner could also add a comment to each mark or use a standard one during marking.

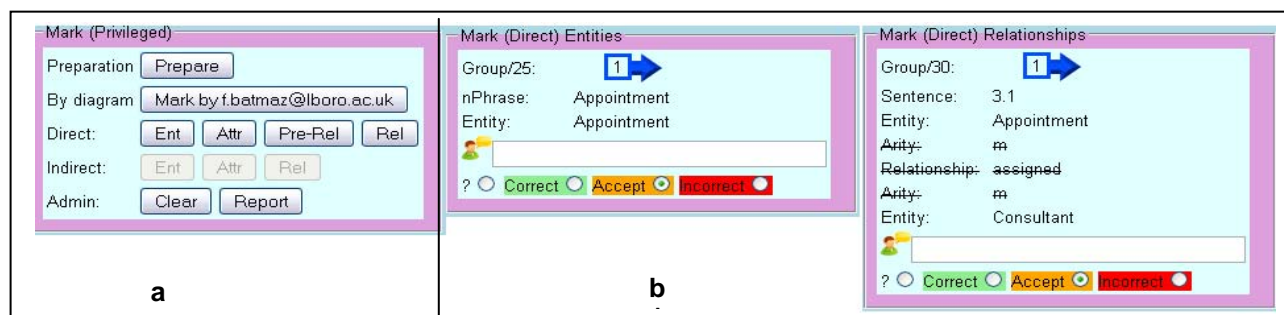


Figure 2 Screenshots of part of the editor interface

The student diagrams are released after the marking is complete. For the student this means that they see another option (checkbox) on their screens which allows them to view the marked version of their diagram. Using this they can view their diagram now coloured in a combination of red, amber and green. If the student moves the mouse pointer over any component in their diagrams, they can see the specific comment for it. In this way the student gets detailed personalised feedback for their work.

5. EXPERIMENT AND RESULTS

The diagram editor has been used with two scenarios by a first year class of 200 students. This represents 4 separate sessions since the first year class had to be split into four groups of 50 students. At the beginning of each 50min practical session a short demonstration of the system was given showing how to make one entity, one attribute and one relationship. The students were then asked to create ER diagrams for the first scenario (hitherto unseen) and if possible go on to do the same for the second scenario. By the end of the session most students had finished the first scenario and some had finished both.

| Scenario No | Total Component # | Component Group # | Diversity Rate % | Auto marked Group # | Manual marked Group # | Efficiency Rate % |
|-------------|-------------------|-------------------|------------------|---------------------|-----------------------|-------------------|
| 1 | 5356 | 708 | 13 | 468 | 240 | 96 |
| 2 | 3707 | 607 | 16 | 317 | 290 | 92 |

Table 4 Summary of diagram marking for two scenarios

The tutor marked the student diagrams by the marking tool in less than two hours. Table 1 shows the summary of the marking task. The tutor marked 240 components out of 5356. That makes the efficiency of the tool for first scenario approximately 96 percent. The efficiency for the second scenario is 92 percent. This might be interpreted such that the system's efficiency increases when more students draw ER diagrams for the same scenario. The table also shows the diversity rate. This rate is calculated by using both component group and total component numbers. If student diagrams are similar to each other then the diversity rate decreases otherwise it increases. Diversity rate could be used as a feedback for the scenarios. Student solutions for the similar scenarios should have the same rate. If they are very different, the tutor may analyse revise the scenario text to find out the reason for the diversity.

The marking tool produces a detailed report for any chosen scenario. The report has a list of every distinct element, how it was marked and the number of students whose diagrams included that element. This reveals for example how many students made the 'same mistake'. So for example it was clear that something in the way the first scenario was worded caused 50 students to wrongly identify "Consultant Name" as an entity and go on to make related mistakes with attributes. The report contains aggregate marks e.g. entities (green 82%, amber 7%, red 11%) attributes (green 82%, amber 10%, red 8%) and relationships (green 34%, amber 59%, red 7%) showing that it is the precise identification of relationships (amber 59%) that caused the most problems.

In feedback sessions, the students were able to see their marked diagrams. The colour coding of tutor comments was extremely well received by the students and led to lively, positive discussion of the principles involved with interpreting the scenarios which was very beneficial. A simple questionnaire about the editor and the associated marking feedback has been given to students at end of the term. The results from 70 returns show that the students were favourably disposed to the editor and they liked the coloured feedback.

6. CONCLUSION AND FURTHER WORKS

Students have readily accepted the concept of using the editor as a way of submitting their work to scrutiny by the tutor in return for more extensive and personalised feedback than would have been possible otherwise. The marking tool has decreased the workload of the tutor and gives the feedback about students' diagramming skills and scenario used in the assessment. Now that a basic system has been implemented where the components of the diagram are directly referenced to the scenario, the next stage is to allow the user to create indirect referenced components by splitting and merging existing elements. The marking tool will be improved to support marking of these components.

7. ACKNOWLEDGEMENT

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DEVELOPING TOOLS TO ENCOURAGE REFLECTION ON LEARNING IN FIRST YEAR STUDENT BLOGS

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ABSTRACT

In this paper, we describe the pedagogical basis of a project aiming to encourage students to engage in reflective activities using blogs that document their learning experiences, and give details of the practical implementation of this work. Basic examples of activities which scaffold the process are discussed, together with a description of some difficulties that arise when the informal aspects of blogging conflict with the desire to use the reflective work as formal evidence of learning in a personal development portfolio. Some suggestions on how these issues may be resolved are presented.

Keywords

Reflection, Feedback, Blogs, Graduate Attributes, Social Software, PDP.

1. INTRODUCTION

The potential for the use of blogs in Higher Education as a vehicle for student reflection on learning would appear to be quite significant. They provide a mechanism through which the student can express a developing, yet locally coherent, learning narrative, while interacting with feedback and commentary from colleagues and tutors. This integration of personal reflective activity with the inherently social character of blogging, as opposed to just keeping a paper-based diary or journal, is appealing from a pedagogical point of view as a means of enhancing both autonomous and collaborative learning.

Two aspects of the use of such blogs seem particularly attractive. Firstly, they can be used to encourage the development of critical and analytical skills which allow students to reflect on their own educational experiences. They can thus provide a vehicle for the articulation and documentation of personally significant insights into the learning process over an extended period of time. This type of reflective practice is a key graduate attribute linked to the enhancement of life-long learning skills and increased employability, and a demonstration of this in the context of a student's progress over a learning cycle could, for example, be seen as an important element of an e-portfolio-based PDP system. Secondly, they provide an accessible communication forum which allows students to engage with lecturers and other students in a way which is less formal than that usually found in the classroom. This may well be used to promote the creation of social networks that support learning, while also providing a natural mechanism which facilitates the process of feedback to and from students.

There are, however, a number of problematic areas associated with the use of blogging to promote learning. The first is that students find such activities extremely difficult unless provided with appropriate scaffolding around which they can develop the skills for self-analysis and reflection. The second is a significant tension between the objective of formal documentation of achievement and that of the use of the technology as an immediate and relaxed communication forum. The spontaneous and informal nature of the latter often militates against the production of work which is useful for recording achievement. Conversely, a clumsy imposition of a formal pedagogical structure can destroy the factors such as spontaneity and informality which promote the kind of social interaction and peer-assisted learning that is seen as desirable in such situations.

This paper describes work done in an ongoing project aimed at addressing the problems indicated above within the context of a 15-credit, two-semester, first year collaborative and professional skills module in the School of Computing at the Robert Gordon University. It details the pedagogical drivers, specifically those associated with feedback, which strongly recommend the use of blogs (as opposed to, say, a paper-based learning journal) as a useful vehicle for promoting reflection. It also describes some features of the system used and the academic structure in which the material used to scaffold these reflective activities was embedded. In addition, it makes some comments on the ongoing investigation into ways in which the activities

can be used for recording competence, while at the same time remaining environments for opportunistic learning, retaining the element of spontaneity and informal social interaction which make them attractive to students. Finally, some observations concerning the wider lessons learned in the project are made.

2. WHY USE BLOGS? - THE FEEDBACK PROBLEM

A recurrent criticism from students, e.g. as detailed in the results of the National Student Survey [1] (reported in [2]), is that there is a mismatch between their expectations of academic feedback and the reality of their educational experience. At the same time, recent work on the use of feedback and “feedforward” techniques to enhance student learning suggests that the conceptual complexity of constructively responding to student work has itself been underestimated, by both academics and students. The feedback process serves a number of purposes, related both to the specifics of the assessment on which it is an outcome, and the more general educational experience in which the teacher and student are engaged. This often leads to confusion when academics use the term in one sense (e.g. as informal reporting on classroom exercises) and students understand it in another (e.g. as formal responses on summative assessment).

While it may be difficult to give an all-embracing definition, a number of projects have attempted to give practical descriptions of the types of features that should characterise good feedback practices. Among the clearest and most useful are the so-called ‘Seven Principles of Good Feedback’ first articulated in the report on the Student Enhanced Learning through Effective Feedback (SENLEF) project funded by the LTSN [3, 4] and subsequently used as an input for the work done by the REAP project [2]. These principles – that feedback should facilitate the development of self-assessment and reflection, encourage teacher and peer dialogue, clarify the nature of ‘good’ performance, deliver high quality information to students about learning, encourage positive motivational beliefs, and provide useful information to teachers – can be used as a set of criteria to review the feedback mechanisms in use in a particular academic programme and they provide a sensible pedagogical underpinning for the incorporation of robust feedback methods when used in the context of a curriculum development exercise. Certainly, they have proved invaluable as guiding principles in the construction of the first year computing curriculum at RGU.

The conceptual model on which the set of principles is based makes use of a distinction between internal and external feedback. The former is derived from the monitoring activity a student performs when assessing their own interaction with tasks set by the teacher and the range of outcomes these tasks produce. It is therefore a comparison between their perceived progress and their perception of what further work needs to be done. External feedback, on the other hand, which may well come from a teacher or another peer, serves to modify the student’s model of the task by acting as one input into this internal process. This model, therefore, places a major emphasis on producing feedback that encourages reflection on work done, and on assimilation of the constructive outcomes of this practice.

2.1 The Use of Blogs and the Seven Principles of Good Feedback

In looking for a vehicle which would allow both students and staff to engage with each of the principles articulated above, the concept of some form of learning journal (whether paper-based, electronic, or simply a set of discrete reflections on learning) has several important features that recommend it. Since the first of the principles is a feedback mechanism that facilitates the development of self-assessment and reflection, a reflective journal is clearly a strong candidate. Learning by making best use of feedback requires the student to develop a capacity for self-regulation. This requires the activities to be structured so as to allow the students themselves to monitor their own progress with respect to assessment objectives and to reflect on different aspects of the learning experience. According to the SENLEF report [4], examples of such structured reflection might include activities in which students identify strengths and weaknesses in their own work or in those of their peers, based on a given set of grading criteria, or in which they make careful attempts to select a set of appropriate examples of good work in order to compile a portfolio.

The specifically social features of a blog provide a strong recommendation for their use over and above a paper-based learning journal in trying to facilitate teacher and peer dialogue about learning. The commenting feature allows both teachers and students easily to give feedback on a piece of work, and explanations of difficulties from peers may well be articulated by students at a more appropriate level and be perceived as less of a threat to self-esteem. Peer feedback also has several advantages in terms of the alternative perspectives it may present on a problem and the different strategies for solution. This can serve to both motivate perseverance in tasks and provide a degree of support and validation for efforts made. In an academic context, this interplay between social support and formal academic instruction serves to make the blog a powerful instrument for the construction of peer mentoring systems. However, the practice of making comments on work done by their colleagues also allows students to develop the ability to make objective judgements with reference to externally-set marking criteria, a capacity which can then hopefully be transferred to their own work. This ongoing student-teacher and student-student dialogue also serves to clarify

the subtler (and often unstated) characteristics of what counts as “good performance” in the context of a particular assignment. This monitoring, by the student, of the gap between their own understanding of high performance and that of the teacher and their peers is crucial to the development of appropriate mental models of the learning process. Moreover, the repetitive nature of tasks like blogging also increases time-on-task and allows students to iterate the feedback cycle in a natural way.

While it is quite difficult to provide an exhaustive account of what precisely is meant by high quality feedback, there are several characteristics which would reasonably be expected to appear. The use of commentary to provide feedback which empowers students to discern the strengths and weaknesses of their performance is clearly relevant (provided it is given in a timely manner) since this gives students the opportunity to exercise judgement in how they may subsequently modify their own work and so increase their autonomous learning. This link between successful reflective practice and increased learning autonomy suggests that blogs may nevertheless be used profitably to encourage an atmosphere of developmental improvement in which students are able to realise that the relationship between their current state of knowledge and the established subject matter does indeed evolve. Understanding that the acquisition of expertise does not happen instantaneously and that their conceptual model of a topic will change, evolve and deepen over time is a significant educational milestone.

Finally, blogs give a useful two-way feedback mechanism which allows students to themselves offer commentary on the provision and suitability of teaching activities. They can therefore be used to provide high quality information to teachers about the nature of the student experience. This may go well beyond academic concerns and offer insights into the social, economic and intellectual milieu of the student which may, for example, affect the way in which the course is delivered or simply increase the teacher’s appreciation of the (variety of) student experiences.

2.2 Implementing the Blogging Environment

Having taken the decision to use a blog as the vehicle for reflection and as a mechanism for feedback, a number of implementation decisions presented themselves. The most immediate was the hosting context. In this particular case, because of institutional concerns over the possibility of on-line antisocial behaviour, it was decided that the blogs would be hosted internally. This provided a comprehensive degree of access control that was not possible with externally hosted systems and the ability in the worst-case scenario of being able to simply shut the system down.

A second choice concerned the level of implementation. Blog creation facilities on external sites such as Blogger [5], or professional tools such as Wordpress [6], have a range of features including a variety of design templates, as well as the ability to integrate with an array of applications such as RSS feeds. While incorporation of these may well be important for long term development of the module content, they can serve to distract attention from the pedagogical goals of the exercise and consequently it was decided to use a minimal implementation of a blog based on the Drupal content management system [7]. This provided an environment in which it was possible to display and comment on blog posts, but it could also act an electronic repository of work and so form the basis of an e-portfolio system.

A further decision concerned the nature of the student contribution, namely whether the activity should be voluntary or compulsory. It was decided at an early stage to make the activity compulsory by embedding it as a task within a module which required some degree of student participation in order to pass (i.e. contribution was indicated as one of the module learning objectives). This allowed a degree of assessment to be placed on the activity which served to increase its importance as perceived by students. Finally, throughout the duration of the first year, it was stressed that the medium itself could also be used for more informal purposes such as a forum for debate about issues surrounding the first year experience.

The blog posts themselves were not anonymous, although the identifier was the student matriculation number rather than the name. However, as this was linked to a profile page with personal details, there was little doubt about the authorship of any particular post. Students did have the option to make posts private or public. If the post was private, the material would only be visible to the author and members of academic staff whereas if the public option was chosen, the material would be visible to all users, and as well as being placed in the student’s own blog, a copy would be put into the Community blog which aggregated all public posts and indicated, for example, if a new post or a new comment had been made. Despite some initial fears that students would be reluctant to allow other students access to their posts, there has never been a single occasion when a student has chosen to make a post private.

Posts themselves were tagged with a minimal set of information (matriculation number of poster, module code of subject – see below) but the student could include any suitable tag. This information was displayed on the System homepage as a tag cloud using a variable-size font.

3. MODULE STRUCTURE

The CM1013 Collaborative and Professional Skills module, in which this work is embedded, is a 15 credit first year module which runs over both semesters and is taught to all computing undergraduates. The extended duration of the module means that there is considerable flexibility in terms of the types of activities that can be included as the basis for reflection. In addition to this, each student was also studying three other 30 credit technical modules (software development, information systems and problems solving) which also lasted two semesters (and a further 15 credit technical module in semester 2).

3.1 Activities

Two kinds of task formed the essential student activity of this module. Firstly, each student was required to keep an individual blog and post a minimum of two hundred words on each technical module per week describing their learning experience. It was envisaged that this would form part of an e-portfolio of work which would accompany the student throughout their course of study and could, potentially, form the basis of further reflective activities in later years. In addition to posting their own reflections, there was a requirement that they make a substantive comment on two other posts each week and time was set aside in class to allow for these activities. A default template for reflective comments was distributed providing some basic scaffolding for these exercises. This consisted of a number of questions which asked the student to identify the major learning objectives covered that week, detail new information the student had assimilated, comment on any learning strategies they had adopted, and describe affective reactions to the classes had they experienced.

The second kind of activity provided more structured opportunities to develop and enhance the kind of skills now being termed 'graduate attributes' (see e.g. [8, 9]). These include the ability to exercise critical thinking, to access, evaluate and synthesise information, to communicate effectively and to work successfully both independently and in teams, and to demonstrate leadership, professional behaviour and ethical practices. The initial module exercises were discursive in nature and focussed on the purpose of the module and the idea of graduate attributes (over and above subject-based technical competencies). These were then followed by an introduction to the computing infrastructure relevant to the module, e.g. the blogging environment. To familiarise themselves with this, students were asked to create initial blog posts which gave a short personal description together with their aspirations for the coming year. Further activities engaged with issues in the psychology of learning such as a discussion of different learning styles (following Honey and Mumford [10]), a discussion of individual roles within a group or team (following Belbin [11]) and a survey of the use of cognitive aids to learning such as mind-maps, concept maps, and academic writing in general. Other topics covered throughout the year included ethical discussions centred on the varieties and implications of academic misconduct (e.g. collusion and plagiarism), discussion and formulation of peer and self-assessment criteria for extended group work activities, and investigation of issues surrounding employability. A general problem-based learning approach was taken with these exercises, with relatively open-ended, divergent tasks being set, often (at least initially) in a group-working context. As stated above, it was stressed to the students that the medium itself could also be used for more informal purposes such as a forum for debate about non-academic issues surrounding the first year experience.

In order to assess the effectiveness of different ways of delivering instructions, the scaffolding required for reflection was presented in a variety of forms: verbal instructions given with the task itself, written instructions given with the task, and general verbal instructions about documenting reflection in the context of a learning journal.

3.2 Evaluation Methodology

Several evaluation tools were used to gauge student reaction to the activities. Information from two questionnaires, one given at the beginning of the semester on academic expectations and aspirations and a similar one given at the end of the semester, was obtained in order to cross-correlate with a final end-of-year questionnaire looking at student perceptions of their own performance and reflection on lessons learned. In addition, a focus group of second year students was used to inform development and delivery of material. It was anticipated that these second-year students would, given suitable training, form a mentor group for the first year blogs.

4. RESULTS

Although this project is still ongoing, a number of interesting issues have emerged, most of which illustrate to varying degrees, the unpredictability of effects of the technology. The students quickly colonised the virtual space for their own use, setting up threads for discussion of non-academic topics (favourite film, favourite type of music, etc) and this may well have influenced their perception of the medium when it came to using it for academic purposes. It became evident that although teachers saw a distinction between student use of blogs to foster activities such as peer support or engagement in discussions about their learning experience on the

one hand, and the PDP-like tasks of recording reflections to illustrate conceptual growth on the other, students did not reflect this difference in their work, using similar standards for presentation and content in both. For example, the use of written language in any task with a social dimension (even if it was directed to a conventional academic activity) remained resolutely informal, with texting-style posts lacking conventional grammar and punctuation being common. This problem was persistent and was only partially alleviated by providing students with templates for their responses.

A second concern is that while a majority of students engaged substantively with the medium, (even if they did not necessarily use it in the way that had initially been anticipated), there remained a small cohort of students who refused to contribute at anything above a minimal level. Most of these students stated that they did so because they saw no benefit in reflective activities, but some indicated that they used social software (Facebook, Bebo, etc) in a non-academic setting but could not understand the point of the chosen minimalist implementation which they felt militated against participation.

Despite these occurrences, the majority of students engaged with the blogs in ways which elicited positive responses and were educationally constructive. Many students chose to interact with the medium from outside the university and at times which often extended to the early hours of the morning. While the quality of the reflection may have, at times, been somewhat basic, it nevertheless represented the initial stages in a process which was projected to continue throughout the student's undergraduate career.

5. CONCLUSIONS

While some students may have found the exercise somewhat frustrating, the majority used the blogs in an educationally constructive way. However, one interesting aspect of the project which deserves to be mentioned is the response of academic staff. All teachers involved felt strongly that the experience of reading and commenting on the student blogs had been overwhelmingly worthwhile due to the quality of the information gleaned on the student learning experience. The day-to-day reportage of first year experiences of issues surrounding teaching styles and lesson content, problems with lab exercises, and assessment difficulties, as well as non-academic issues such as finance, was found by staff to be an invaluable source of feedback which allowed them to better tailor subsequent lessons to the concerns of the students. The medium allowed the initiation of a mature dialogue about topics like the relevance of parts of the curriculum, and encouraged the formation of both academic and social peer support structures among the students.

Perhaps the most significant feature of the blogs from a staff perspective was that, even for experienced teachers, it opened a window on the student experience which generated much greater empathy for the routine problems and challenges that students faced. This fact was acknowledged by students and has been a major contribution to the socialisation of the classroom which has improved the general working environment of both academics and students alike.

6. ACKNOWLEDGEMENTS

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EVALUATING A SYSTEM SIMULATOR FOR COMPUTER ARCHITECTURE TEACHING AND LEARNING SUPPORT

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ABSTRACT

An integrated, multi-level software system simulator has been developed to support teaching and learning of undergraduate computer architecture and operating systems modules. In this paper the rationale for the development of the simulator and its main features are described; the teaching and learning strategy is briefly explained; the simulator evaluation methodology is defined and the preliminary results of the evaluation are presented.

Keywords

Computer architecture, operating system, simulation, computer-aided learning, visualization.

1. INTRODUCTION

Many software-based simulators have been developed for educational purposes [4]. These range from relatively simple, visual simulators to advanced, complex simulators for research and product development. One area where software simulators have become almost indispensable is in undergraduate computing courses. These simulators are often used to aid student's understanding of complex technologies which are difficult to conceptualize and visualize without the help of graphical animations that the modern simulators can offer.

In today's undergraduate computing education, it is almost impossible to treat computer architecture and operating systems, including compilers and code generation, in complete isolation from each other without demonstrating the interdependencies and the co-operation between them. This has lead to a requirement for a system simulator that *integrates* all these areas in one software package. Such a simulator has been developed by the author and has been supporting the practical sessions in his modules for the past two years. The rest of the paper describes the main features of the simulator and gives an account of the evaluation process.

2. THE INTEGRATED SYSTEM SIMULATOR

The integrated simulator is composed of three main components: a *teaching* compiler, a CPU simulator and an operating system (OS) simulator supporting each other. So, for example, the compiler will generate code which can be run by the CPU simulator either in isolation or under the control of the OS simulator for multiprogramming support. Each of these three components is briefly described in following sections. More detailed description of the simulator can be found in [3].

2.1 The Compiler

A basic but complete high-level teaching language is developed to support the CPU and OS simulations. This language incorporates standard language control structures, constructs and system calls which are used to demonstrate a modern computer system's key architectural features. A *teaching* compiler is developed for this language that can generate both assembly-level language and its equivalent binary byte-code as output. The students can analyze the assembly and the binary code generated against the high level language statements.

2.2 The CPU Simulator

The CPU is based on RISC architecture with a register file composed of up to 64 configurable registers, a small set of instructions and a limited number of addressing modes. The CPU simulator includes animated cache and pipeline simulations in support of more advanced modules. Figure 1 shows the main user interface for the CPU simulator. The CPU simulator supports multiple processor simulations where each processor is

identical and loading code in one CPU is duplicated in others thus simulating shared memory, tightly-coupled architecture. It is capable of executing a typical set of low level instructions at selectable simulation speeds and includes breakpoint facilities which can suspend simulations according to some defined conditions. The simulator supports a list of vectored interrupts and each interrupt vector is triggered by a pre-defined event, e.g. console input or timer event. The built-in high-level teaching language and its compiler include constructs supporting this feature.

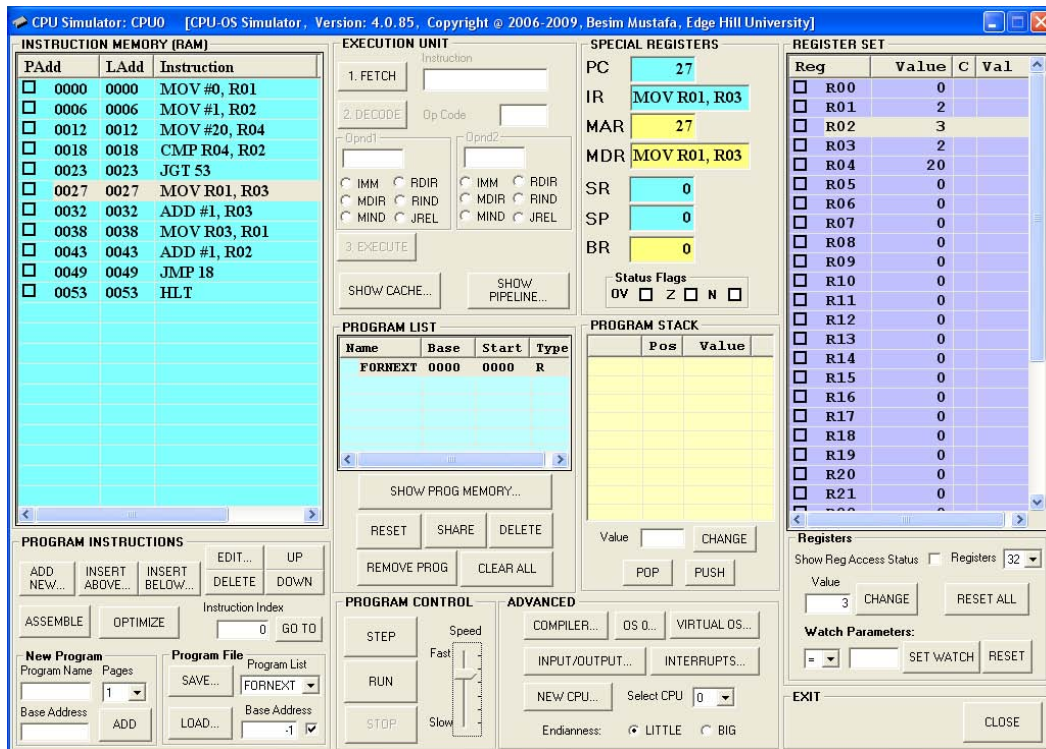


Figure 1. The main simulator user interface.

2.3 The OS Simulator

The OS simulator is designed to support two main aspects of a computer system's resource management: process management and memory management. All CPU code is available to the OS simulator which is able to create multiple instances of the code as separate processes. The process scheduler includes support for scheduling policies including priority-based, pre-emptive and round-robin scheduling. Virtual resources can be allocated and de-allocated to processes allowing demonstration of deadlocks associated with resources and investigation of deadlock prevention, detection and resolution techniques. Threads are supported via special teaching language constructs which allow parts of program code to be executed as threads and process synchronization concepts to be explored.

3. THE TEACHING AND LEARNING STRATEGY

The simulator has successfully been integrated into modules on computer architecture and operating systems and has been in use for the past two years. During each two-hour practical tutorial session the students work in small groups. The simulator software is provided on a removable disk drive and runs under Windows operating system. The exercise questions are designed to encourage critical thinking and deeper understanding of the concepts under investigation. The year one students study the introductory computer architecture module and use the simulator to explore CPU instruction sets and experiment with the assembly language programming. They also get to know the role of OS in managing hardware resources and process scheduling. The year two students study advanced computer architecture and concentrate on performance issues. Here they work with the cache simulator, the CPU pipeline simulator and the teaching compiler optimizations all of which are part of the integrated system simulator described above.

4. SIMULATOR EVALUATION

Although the simulator has been in use in both the introductory and in the advanced modules it became necessary to evaluate its effectiveness as a useful teaching and learning tool and at the same time use the resulting feedback to improve its functionality and pedagogical value.

4.7 Methodology

The evaluation of the simulator was carried out using both qualitative and quantitative methods. The qualitative method used opinion surveys. The surveys were implemented using 5-point Likert scale as well as some open questions. The quantitative method used quasi-experimental procedures with test and control groups as well as pre and post tests. A similar study involving a cache simulator is described in [1].

4.8 Participants

The participants were composed of 36 first year computing degree students studying the introductory computer architecture module and 18 second year computing degree students studying advanced computer architecture module. The first year students participated in two groups; one of the groups was used as the control and the other as the test group. These roles were then reversed. The second year students participated in a single group. These students were given the pre and post tests. The tests mirrored the same topics covered by the tutorial exercises using the simulator. One additional qualitative dimension was provided by the observations of the three tutors who facilitated the evaluations during the practical tutorials. In order to minimize disruptions to the students the evaluation was carried out during the scheduled tutorial sessions and as a result the groups were not randomly selected for the evaluation.

4.9 Summary of Results

4.9.1 Qualitative Evaluations

Two opinion surveys were conducted. One of the opinion surveys was conducted at the start of the evaluation phase and another at the end of this phase which lasted six weeks. A total of 29 students participated in survey 1 and a total of 42 students participated in survey 2. Figure 2 shows the eight opinion questions included in the first survey. The *Strongly Agree/Agree* and the *Strongly Disagree/Disagree* results are aggregated and the results are presented as percentages of participants.

| Question | Strongly Agree + Agree (%) | Strongly Disagree + Disagree (%) |
|---|----------------------------|----------------------------------|
| The simulator helped me understand the theory and concepts covered during the lecture better | 79.3 | 10.3 |
| I got more confused about the CPU architecture when I used the simulator during the tutorial | 20.7 | 72.4 |
| I was encouraged and enjoyed exploring different aspects of the CPU architecture using the simulator | 79.3 | 13.8 |
| I spent more time learning how to use the simulator than actually doing the tutorial exercises using it | 20.7 | 72.4 |
| The simulator encouraged the members of my group to work together in order to solve the tutorial problems | 79.3 | 10.3 |
| I found the simulator exercises supportive of and appropriate for the topics covered in the lecture | 89.7 | 6.9 |
| I know of/used other software or method more suitable than the simulator for understanding of the subjects covered in the lecture | 6.9 | 79.3 |
| The tutorial exercises using the simulator were set at the appropriate level of difficulty and challenged me | 79.3 | 17.2 |

Figure 2. Opinion survey 1 results.

Survey 1 was conducted at the beginning of the evaluation period since the participants were already familiar with the simulator. The results of the first survey indicate that over 79% of the students were of the opinion that the simulator helped them understand better the theory and the concepts covered during the lectures. They were also encouraged to explore further and to work better in groups. This was also confirmed by the observations of the tutors who supervised the evaluation sessions. However, over 20% of the students thought that the simulator was complicated to use. This is a relatively significant number and needed to be

addressed. Figure 3 shows the questions included in the second opinion survey. This survey was conducted at the end of the evaluation period and indicates that over 95% of the students were happy using the simulator and regarded it as an effective and useful educational tool with a small number still finding it complicated to use. This suggests that the students can get used to and like the simulator in a relatively short period of time.

| Question | Strongly Agree + Agree (%) | Strongly Disagree + Disagree (%) |
|--|----------------------------|----------------------------------|
| Overall, the simulator has been a useful tool in understanding some of the more difficult concepts | 95.2 | 0 |
| I found the simulator too complicated to understand and use effectively in most simulator-based tutorials | 7.1 | 81 |
| The simulator has been more effective in helping me understand some of the difficult concepts than reading the text books or searching on the Internet | 95.2 | 0 |

Figure 3. Opinion survey 2 results.

The system simulator is a highly configurable, interactive and visual teaching and learning tool. It is expected to be most effective for those students who preferred visual and hands-on approach to learning. In order to establish the range of learning styles of the participating students, we then surveyed 42 students for their learning styles. The results of this survey are listed in Figure 4. It appears that 83% of the participating students characterized themselves as visual or kinesthetic (i.e. learning by doing) type learners. This is in agreement with our expectations which gave us confidence in the validity of our participants and the evaluation results. All first-year students are encouraged to take an on-line diagnostic test at the start of the academic year for skills and learning style auditing.

| Learner style | Number(%) |
|---------------|-----------|
| Visual | 31 |
| Auditory | 5 |
| Kinesthetic | 52 |
| Reader | 7 |

Figure 4. Learning styles survey results.

Additional qualitative data was obtained from three other sources. These are based on three participating tutors' observations, responses to the open questions in both surveys and the student reflections on individual tutorial sessions included in their tutorial portfolios. The tutors' observations confirmed that the students tended to work together better when using the simulator and that they were also encouraged and motivated to attempt and solve more exercises. The responses to the open questions and the portfolio reflections are mostly supportive of the simulator-based tutorial exercises with only one student disliking the use of a simulator.

4.9.2 Quantitative Evaluations

The results of the quasi-experimental methods at first sight do not seem to agree with the general sentiments of the opinion surveys. Figure 5 and Figure 6(a) show the results of the pre and post tests carried out over four scheduled practical tutorial sessions. The students were given the pre test quiz followed by the exercises. At the end of the exercises the students completed the post test quiz. Both tests included questions which reflected the tutorial exercises. Although the average results do not show significant improvement, there were significant improvements in some of the individual post test results. Not surprisingly these *hot-spots* were found to correspond to questions with mainly visual elements. During the evaluation period the students received minimum guidance and help from the observing tutors in the hope that they will be encouraged to construct knowledge guided by what they learned during the lectures and their experiments with the simulator. It may be that this was an inappropriate strategy for these particular participants and needs re-considering. The failings of *minimal guidance during instruction* aspect of learning theory are explored in [2].

Evaluating the results of a different aspect of student learning involved a control group and an intervention group of first year students and is shown in Figure 6(b). Both groups were given brief descriptions of a number of small programming exercises and were asked to translate these into high-level programming constructs.

| (a) Subject: Investigating Compiler Technology (% correct answers) | | | | | | | | | |
|--|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| Test | Replies | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Avg. |
| Pre | 19 | 62.5 | 45.3 | 18.8 | 23.4 | 28.1 | 15.6 | 6.3 | 27.3 |
| Post | 19 | 78.6 | 44.6 | 64.3 | 12.5 | 35.7 | 21.4 | 0.0 | 36.4 |
| (b) Subject: Understanding Instruction Pipelining (% correct answers) | | | | | | | | | |
| Pre | 16 | 93.8 | 75.0 | 56.3 | 87.5 | 43.8 | 81.3 | 37.5 | 67.9 |
| Post | 17 | 100.0 | 82.4 | 23.5 | 76.5 | 64.7 | 94.1 | 58.8 | 71.4 |
| (c) Subject: Investigating Cache Technologies (% correct answers) | | | | | | | | | |
| Pre | 18 | 50 | 72 | 100 | 78 | 100 | 78 | 50 | 75.4 |
| Post | 17 | 59 | 76 | 88 | 76 | 94 | 76 | 53 | 74.8 |

Figure 5 – Pre and post test results (2nd year students).

The control group did this as paper exercise; the intervention group used the simulator. The students' work was then assessed on the basis of attempts and correct results. The results indicate that the students using the simulator achieved significantly improved scores in the number of attempts and the correct solutions. One possible conclusion is that the use of the simulator had a positive effect on student motivation and engagement with problem solving as co-operating team members whereas this was not as apparent in the control group, attempting similar exercises but on paper, while being observed by the facilitating tutors.

| (a) Subject: Programming Model - HHL statements and the code generated (% correct answers) | | | | | | | | |
|---|----------------|------------------------------|-----------|-----------|-----------|----------------------------|-----------|-------------|
| Group Test | Replies | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Avg. |
| Pre-test quizzes | 18 | 55.6 | 83.3 | 88.9 | 50.0 | 61.1 | 72.2 | 68.5 |
| Post-test quizzes | 18 | 44.4 | 88.9 | 66.7 | 77.8 | 66.7 | 94.4 | 70.3 |
| (b) Subject: Programming Model - Elements of high-level languages | | | | | | | | |
| Group Type | Replies | Average Attempted (%) | | | | Average Correct (%) | | |
| Control group | 19 | 77 | | | | 59.8 | | |
| Intervention group | 19 | 93 | | | | 75.7 | | |

Figure 6 – Pre-post and control-intervention test group results (1st year students).

5. CONCLUSION

The evaluation strategy adopted in this study was designed to highlight the effectiveness of the simulator and was conducted during the scheduled group tutorials for a relatively short period of time (part of one semester). As a result, the number of students participated and the topic areas covered were less than ideal. Nevertheless, the preliminary results have been generally positive and the simulator is seen to be supportive of the theory covered during the lectures. It is our intention to build on this work by carrying out a longer period, i.e. two semesters, and a more thorough evaluation, i.e. larger number of participants, in the near future.

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DETECTING PLAGIARISM IN MICROSOFT EXCEL ASSIGNMENTS

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ABSTRACT

We present a new anti-plagiarism tool called Excel-Smash. Whilst there are already anti-plagiarism tools available for essays and programming based submissions, our tool to the best of knowledge is the only tool designed to compare student submissions in the form of Microsoft Excel spreadsheets. We present details of the plagiarism checks performed and we test our software on over nine hundred current and past student submissions.

We present a case study to show how Excel-Smash functions from the point of view of the user, and we present data to support the ability of Excel-Smash to identify plagiarism between different marker groups above the abilities of its human counterparts. With a low false positive and false negative result Excel-Smash quickly allows identification of serious and more minor inter-group plagiarism.

Keywords

Plagiarism, plagiarism detection, academic malpractice, anti-plagiarism software

1. INTRODUCTION

Plagiarism is acknowledged as a growing and difficult problem within academia. Data suggests that over 10% of submissions may require extra scrutiny [2]. Students seem to find plagiarism widely acceptable [7] and attribute it to a variety of reasons including: “a lack of time”, “a friend needed help”, “it’s easy to do” or “everyone else is cheating” [3]. Good practice dictates that we educate our students about what constitutes plagiarism and the penalties if they are found to have committed it [1]. This does not mitigate academics duty to be vigilant and ensure that everybody, isn’t in fact, cheating.

Modules with large cohorts with multiple markers pose the question of how to detect plagiarism across groups. Extensive literature and tools are dedicated to the automatic detection of plagiarism within written essays and computer programs (examples include TurnItIn [5], or Moss [6]). These tools seem well adopted and a useful addition to help monitor plagiarism. Until now, to the best of our knowledge no tool has been available specifically for assisting in detecting plagiarism in Microsoft Excel assignments. We present Excel-Smash, the first such tool and analyse its benefits.

2. BACKGROUND

The Computing Laboratory within the University of Kent provides a taught module for approximately 400 first year Business School students. The course is task oriented and involves extensive use of spreadsheets to solve real world problems. A stated learning outcome for the module is “Design and implement a maintainable, well-documented spreadsheet suitable for users other than the author”. This outcome is assessed by coursework and assigned a weighting of 16% of the final module mark. The module curriculum covers a number of spreadsheet features required to solve problems, and the mark scheme applies marks for each skill demonstrated. Previous assignments have included problems based on a pension scheme forecast and a personal loan calculator. Both problems require students to develop fully functioning spreadsheets with input fields, output fields and a chart element.

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Good pedagogical practice, (where possible) designs out plagiarism by offering an open assignment with numerous solutions [1]. Offering students free rein to choose their own assignment would be very onerous on the markers when ensuring correct solutions (400 spreadsheets to mark). It is with this constraint in mind that the assignment specifies a set numeric problem and encourages students to practice good spreadsheet design in line with the format presented in the course material. As such there will be similarities in the numeric content and the structural layout of individual spreadsheets, however, students are free to choose the most appropriate methods and layouts which results in individuality for unique submissions.

Forty students are supported by a seminar leader and three peer tutors providing guidance during class exercises. The assignment is submitted to a central server in electronic format (after the deadline submission is not possible) and then usually marked by the student's seminar leader.

In previous years markers have detected intra-corporal plagiarism [4] within their own marking groups, but concerns remained about students in different marking sets escaping detection. Table 1 shows the raw data upon which these suspicions were based.

| Year | 06/07 | 07/08 | 08/09 |
|-----------------------|-------|-------|-------|
| Number of Students | 361 | 382 | 413 |
| Suspected Intra-Group | 8 | 25* | 5 |
| Suspected Inter-Group | 2 | 10* | 2 |

* Several markers detected large sets of intra and inter group plagiarism, prompting additional checking for all markers. The 08/09 cohort might have been deterred from cheating due to feedback from the year before

Table 1 Suspected Inter and Intra Group Plagiarism for the Past Three Years

3. REQUIREMENTS

To detect inter-group plagiarism we decided to implement our own detection system to support the analysis stage of the Culwin-Lancaster plagiarism detection process [4]. Spreadsheets are comprised of both textual elements (e.g. text cells, graph legends) and data elements (e.g. numeric cells, formula cells). Detecting plagiarism within this varied data requires a combination of differing approaches and cannot be mapped to existing solutions focused on detecting plagiarism within program code or written essays.

Spreadsheet files (specifically Microsoft Excel .xls, .xlsx and .xlsm files used for Excel 97-2003 and 2007) not only contain data describing the contents of each spreadsheet cell but also data explicitly documenting the author, time created, time last saved, original creator and company. This metadata is viewable to any user via "File -> Properties" and had up to now been the only way markers could question the integrity of a student's work. Unfortunately this metadata can be altered or even removed by a knowledgeable user, decreasing the chances of being caught for plagiarism.

Whilst metadata can provide useful clues about a file's originality it was decided to also attempt plagiarism detection by comparing the internal contents of each spreadsheet. If work is copied, even if the metadata is altered, the internal contents will remain the same unless substantial effort is made to alter the document.

Speed is obviously desirable, but for the plagiarism detection system to be of value its output must be clear and comprehensible to non computer experts who might be charged with dealing with any arising plagiarism cases. The following sections present our methodology and initial results for Excel-Smash.

4. METHODOLOGY

Firstly Excel-Smash attempts to load all student submissions from the top-level of a directory hierarchy containing a unique directory for each student. Students who have failed to submit electronically are silently ignored (as they will receive a mark of zero anyway). Students who submit multiple files (often both .xls and .xlsx) cause a warning to be printed to the screen and no further processing of their submission occurs. It is easy to run Excel-Smash once, identify and remove erroneous multiple submissions and then re-run Excel-Smash a second time to ensure all student submissions are processed.

Each submission is processed, attempting to extract data from the spreadsheet. The current version of Excel-Smash supports all character sets and Office 97-2003 and 2007 spreadsheet formats, although it is not capable of processing sheets that use passwords for content protection. If the file cannot be read at all the submission is ignored and a warning printed, if only the metadata can be read a warning is printed but processing continues.

As each submission is processed a data structure is built containing: user login; file metadata properties; a representation of all text cells; and a representation of all formula cells. Numeric cells are ignored because their values are dictated in the assignment.

Once all submissions are loaded, every possible pair of submissions is compared. Comparing each submission involves a series of tests (as detailed in Table 2). If the submissions fail a test suggesting plagiarism, a red flag and severity score is applied to both submissions. Several tests operate on each file individually. These tests are based on feedback and intuition from markers and are documented in Table 3.

Once all submissions have been compared the score for each submission is totalled. If, and only if, the submissions score is greater than a predefined threshold, the details of the submission and failed tests are presented to the user. This mechanism permits the user to vary the threshold, thus changing the size of the net cast over suspected submissions.

The severity for failing a test is customizable. With a threshold score of 5 before a submission is highlighted as suspicious, experimentation has led us to the values in Table 2 and Table 3 for the specified metadata tests. The severity for each test must balance between the risk of ignoring potential plagiarism and the possibility of false positives.

It is important to examine the output from Excel-Smash in detail; a single failed test may indicate a case of plagiarism. The suggested mode of use for Excel-Smash is analysing all submissions prior to marking, allowing the markers to be guided by the plagiarism warnings.

| Pair-wise submission metadata test | Severity |
|--|----------|
| Is submission 1 login equal to submission 2 author? | 5 |
| Is submission 2 login equal to submission 1 author? | 5 |
| Is submission 1 login equal to submission 2 last saved by? | 5 |
| Is submission 2 login equal to submission 1 last saved by? | 5 |
| Is submission 1 author equal to submission 2 author? | 5 |
| Is submission 1 last saved by equal to submission 2 last saved by? | 5 |
| Is submission 1 creation time similar (within one minute) to submission 2 creation time? | 1 |

Table 2 Meta Data Tests Applied when Comparing Two Submissions

| Individual submission metadata test | Severity |
|---|----------|
| Is the author not the same as the last saved by? | 2 |
| Company name does not match "University of Kent"? | 2 |
| Final save time less than one hour after the creation time? | 1 |
| File created between 00:00 and 06:00am? | 1 |

Table 3 Individual Meta Data Tests

Each assignment expects students to add descriptive text within the spreadsheet to explain its function and the meaning of input and output cells. Where possible these text strings are extracted when processing the submission and compared to all other submissions. As these text entries are often short, complex language processing or matching is not warranted (and unfeasible). The approach we take is a simple string matching test after converting each string to lowercase, therefore submission A containing "Please Enter Your Annual Salary" will not match submission B containing "Annual Salary" but will match submission C "Please enter your annual salary" (note the student has changed the case of each word). In our current version of Excel-Smash we mark any two submissions with >50% textual matching as suspicious minimising false positives due to common strings. Due to the serious nature of cutting and pasting between two students work we add a score of 5 (with a default threshold of 5 this automatically causes the students' work to be displayed as suspicious) to each submission for a 50% content match (6 for 60% and so on). We have found this simple mechanism to be highly effective in detecting genuine cases of plagiarism.

The last key element in automatically detecting plagiarism is examining the formulas between two spreadsheets. Whilst all correct formulas will evaluate to the same value, there are numerous ways to specify each one (spacing, brackets, operand ordering, cell referencing etc). It is highly improbable that two independent submissions will contain a high degree of matching formulae; to this end we use another string matching operation for formula cells to compare submissions and detect plagiarism. Any two submissions with >50% formula content receive a score of 5 added to them (6 for 60% and so on). Whilst this mechanism has so far been effective we recognise that it is easy to defeat, for example, inserting a column or row alters all of the cell references causing string matching to fail. Subsequent versions of Excel-Smash will seek ways to improve the robustness of this test.

5. RESULTS

Our results are split into two sections. The first of these demonstrates to the reader a small case study using Excel-Smash with example output. The second section compares Excel-Smash results with group data from the year in order to establish in which areas Excel-Smash contributes to plagiarism detection.

Case Study

In this case study, we ran the Excel-Smash software on our 2007-2008 cohort of the module. We present selected anonymised outputs from Excel-Smash which took less than two minutes to analyse the cohort.

Example 1:

```
Login: aaaa --- Severity: 7
RedFlag Type: Author match xxxx with: bbbb --- Severity: 5
RedFlag Type: Author xxxx and last saved by aaaa mis-match --- Severity: 2
```

In example 1, we see that student aaaa and student bbbb submissions both have the same author name, which has added a warning score of 5. In addition, there has also been a red flag added because student aaaa's last saved by value did not match the original author value.

Example 2:

```
Login: cccc --- Severity: 23
RedFlag Type: Similar creation time to dddd --- Severity: 1
RedFlag Type: Similar creation time to eeee --- Severity: 1
RedFlag Type: Similar creation time to ffff --- Severity: 1
RedFlag Type: 100% similar text to ffff --- Severity: 10
RedFlag Type: 100% similar formula to ffff --- Severity: 10
```

In example 2 we see evidence leading us to suspect students cccc and ffff. The similar creation times to dddd and eeee could be coincidence, however the 100% text and formula match between cccc and ffff is strongly suggestive of plagiarism. If Excel-Smash was run as suggested before marking it would be prudent to ensure the same marker marked both cccc and ffff to establish if the software's warning were correct.

Results Comparison

We now compare the performance of Excel-Smash against human markers when detecting suspected plagiarism. We focus on 07/08 as this year had the greatest instance of human detected plagiarism (Table 1)

Figure 1 - A histogram showing the distribution of severity scores for 2007-2008

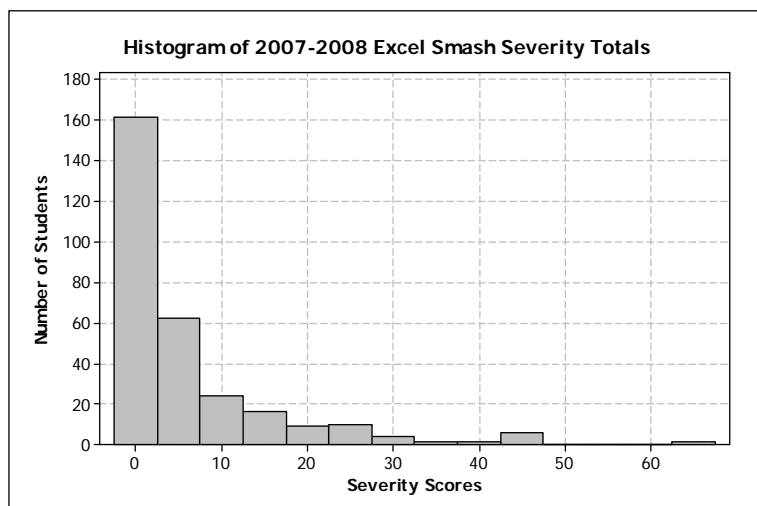


Figure 1 shows that the majority of submissions analysed by Excel-Smash in 07/08 had a severity score of zero. However a notable minority (in this case 95) were highlighted as being above the threshold of 5 that we choose. At the chosen sensitivity (5) Excel-Smash suggests that the level of plagiarism is 2.7 times higher than that detected by humans (35 vs 95).

We have already acknowledged that human markers do a good job of detecting intra-group plagiarism, possibly due to subconscious pattern recognition. Therefore the majority of the additional plagiarism reported by Excel-Smash would be expected to be from inter-group

plagiarism.

Table 4 shows the suspected plagiarism detected by both human markers and Excel-Smash for 07/08.

| | Human Markers | Excel-Smash output |
|-----------------------|---------------|--------------------|
| Suspected Intra-Group | 25 | 13 |
| Suspected Inter-Group | 10 | 82 |

Table 4 Suspected Inter and Intra Group Plagiarism Detected by Humans and Excel-Smash in 2007/2008 Cohort

Table 4 shows that the majority of plagiarism reports generated by Excel-Smash do indeed come from inter-group plagiarism. Intra-group plagiarism was defined as when a submission was reported as only failing individual metadata tests, or only failing pair-wise tests against other students in the same group. Inter-group plagiarism was when a pair-wise test failed against one or more students in different groups. Excel-Smash highlights that twelve of the intra-group plagiarism cases detected by human markers were in fact part of wider cases of inter-group plagiarism undetectable by humans.

Excel-Smash successfully identified serious inter-group plagiarism undetected by markers such as 100% copying of spreadsheets (Example 2) and 100% copying of spreadsheets but with an additional row or column inserted. In future years, with the warnings from Excel-Smash markers will be able to verify if this sort of plagiarism has taken place and initiate disciplinary procedures.

Numerous other cases of inter-group plagiarism were also detected by Excel-Smash, such as where a student had shared their work with a group of friends early into the assignment. The final submissions were usually sufficiently different but their common ancestry could be interpreted as academic malpractice. Suitable measures might want to be taken with these students to prevent this kind of behaviour occurring again.

Within the 35 cases of suspect plagiarism detected by human markers, 19 students were formally disciplined, Excel-Smash reported warnings against 16 of these students. Excel-Smash made warning against 10 of the remaining 16 students identified as suspicious by markers but not formally disciplined. Of the remaining 69 suspect submissions reported by Excel-Smash and not detected by markers some were for serious instances of plagiarism and some for more minor offences. When examined in detail only 10 reported warnings were entirely innocuous indicating the low false positive rate for Excel-Smash.

6. CONCLUSIONS

In conclusion, Excel-Smash has grown from a specific need to compare large numbers of Microsoft Excel files which was previously not possible. We have shown how the software enables us to compare large volumes of submissions in minutes removing the burden from markers and allowing detection of previously undetected plagiarism. A low false positive and false negative rate gives confidence in the results from Excel-Smash allowing the software to be run after submission and its results used as a guide by markers.

Users are able to fine tune the power of their comparison by choosing differing threshold values and severity scores allowing for detection of all or only serious cases of academic malpractice. The tests conducted by Excel-Smash exceed the capabilities of any marker and allow for a greater detection of inter-group plagiarism.

7. ACKNOWLEDGEMENTS

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WRAPPING PROFESSIONAL SKILLS AROUND A SOFTWARE ENGINEERING PROJECT

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ABSTRACT

Software Engineering is a dry subject: the methodologies involved in creating good software may remain obscure to a student who does not experience complex software development. Professional Skills is an equally dry subject: analysis and project planning, assessing risk, achieving success in a group, and focused communication of outcomes may be perceived as largely unnecessary to a student working in an academic rather than professional environment. Software Engineering marries well with Professional Skills in that there is much overlap in approach and desired outcomes. Problem Based Learning is an effective teaching medium for sparking student interest, but may reduce the amount of theoretical knowledge that students acquire. This paper describes a group, Problem Based Learning approach to achieving both improved Software Engineering skills and improved Professional Skills.

Keywords

Evaluating Teaching and Learning, Problem Based Learning, Software Engineering, Professional Skills.

1. INTRODUCTION

There are many different approaches to Software Engineering, but a simple, generic definition is that it is a discipline for managing the process of software development in all its stages [7]. Discipline is necessary because of the increasingly complex nature of software requirements; an ad hoc approach is insufficient for managing complexity and does not have predictable outcomes [5].

Professional skills are usually understood to include generic, transferable skills, such as time management, project management, group working, oral and written reporting. Further to this, for graduates aspiring to Chartered Engineer status, awareness of and involvement in marketing and tendering; ability to deal with complex projects, to schedule activities and to realise and evaluate a product or service are also part of professionalism [6]. From these lists, time management, project management, group working, ability to deal with complexity, to schedule activities and to realise and evaluate a product are professional skills that are also necessary for success as a software engineer.

Problem Based Learning (PBL) was chosen to enliven Software Engineering and Professional Skills teaching through an investigative, hands-on approach [3][8]. PBL allows learning and teaching to take place as students grapple with a complex project, in this case a project that requires software fluency as well as a disciplined, professional approach for a successful solution. However, in order to ensure that students acquire Software Engineering and Professional Skills rather than simply expand their software fluency, assessment must be as much an assessment of processes used, as it is an assessment of outcomes. In that respect, the PBL model does not map well onto real world expectations (in which a successful outcome is often valued above process), even if the competencies gained make a significant contribution to students' professionalism.

This project came about when it became necessary to create a ten credit group project module as part of the second year of an undergraduate Computer Systems Engineering programme. Looking at the programme both horizontally and vertically, it was clear that there was both a Software Engineering gap and a Professional Skills gap in the syllabus. In addition, anecdotal evidence suggested that students needed to improve their confidence in programming. Finally, groupwork is typically a part of PBL, and it had been specified that the module should involve a group project. Thus, setting a PBL project with a relatively complex software task satisfied the requirements for this new group project module.

The biggest limitation of this project was the fact that only ten credits were allocated to it. Acquiring broad and deep Software Engineering knowledge, and achieving fluency in applying this knowledge, arguably will take longer than the 100 hours allocated to a ten-credit module. Assimilation of Software Engineering knowledge

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and skills may be more effective if it occurs through a longer strand in the curriculum [1].

This module has run for two years, in the academic year 2007-08 and the academic year 2008-09. A follow-up look at the confidence of the students in the 2007-08 cohort in their Software Engineering and Professional Skills took place at the end of 2008-09, related to a group project module taken in their third year; these results are reported in section 5. Sections 2-4 discuss the preparation, implementation, and outcomes of the module, and section 6 gives conclusions.

2. PREPARATION

Having set the learning framework and the desired learning outcomes, the next step was to identify a suitable software project. A “dumb” optical bar scanner was chosen: dumb in the sense that it would not decode the signal received. The scanner would be interfaced via a Dsub9 connector, transmitting “high” over a black bar and “low” over a white space. This project was chosen because it involved interfacing PCs to equipment that might be relevant in the commercial world, and because the software required to translate the signal and decode the bars would involve several interdependent functions thus was sufficiently complex to require a disciplined, Software Engineering approach. The previous programming experience of the students on this module comprised one semester of C, and two semesters of Java. The project was suitable for students with intermediate skills in programming in that although there were some logical and interface challenges, it was not too difficult: i.e. it was hoped they would be able to finish the task and also appreciate the professional skills learning wrapped around the project.

Software engineering and project management (one of the professional skills emphasized in this project) methods each can be divided into two categories: traditional methods which rely on a specification at the outset, and agile methods which use an iterative approach to specifying and developing software or projects [2][7]. This project used a specification developed at the outset, but the students would nevertheless be exposed to the need for iteration in the project management and development processes, as they discovered what worked and what did not in their software and their design, and would be able to negotiate changes in the requirements with the module leader, who would act as the “customer” stakeholder.

Because the project was to be done in groups, and the cohort was small (nine students in 2007-08 and eleven students in 2008-09), group sizes were set at two or three people each. One bar scanner was provided for each group; four bar scanners were purchased with funding from a Higher Education Innovation Fund (HEIF) “Business in the Curriculum” project [4]. The HEIF also funded some time for development of the resources for the project.

A project lab was available in the department, having PCs that were suitable for interfacing to the bar scanners, and an appropriate software development environment. The project was to be done in Microsoft Windows, using Microsoft Visual C++. It was also necessary for the lab to have enough space for the groups to spread out, so that although working towards the same outcome, groups were distinct.

A major constraint for the project groups would be the rule that the bar scanning equipment could be used in the lab only, thus imposing time management on the groups in that software inputting from the bar scanner could only be run during timetabled sessions.

Resources were made available on paper and online for the students via the University of Sheffield Virtual Learning Environment (VLE), and included the following:

1. Information about doing a group software project
 - 1.1. Project planning
 - 1.2. Teamwork
 - 1.3. Software lifecycles
 - 1.4. Requirements
 - 1.5. Design
 - 1.6. Verification and validation
2. Information about the bar scanner and bar codes
 - 2.1. The bar scanner product specification
 - 2.2. Links to information about bar code symbologies
 - 2.3. Links to barcodes for experimentation
3. Miscellaneous information
 - 3.1. Creating a project workspace in Microsoft Visual Studio
 - 3.2. MS Visual Studio time reporting functions
 - 3.3. Information about the hardware interface to the scanner
 - 3.4. Information about run time priorities in MS Windows
 - 3.5. An explanation of state machines

4. The Requirements Document for the software

The requirements document for the software was provided because of the ten-credit/100 hour time constraint on the module, although it could be argued that developing this document should be part of the project.

3. IMPLEMENTATION

Three one-hour talks were given at the start of the project to define expectations of the processes that would be used in the project, i.e. that the software was to be developed using Software Engineering principles. After the initial talks, the module leader kept watch over the processes, gave frequent reminders of the way the project should be conducted, acted as an advisor when asked, and also acted as the customer whose requirements should be satisfied.

Learning outcomes and assessment points were described to the students at the outset. The assessment points were these:

1. A group project plan including a Gantt Chart. This was marked for a thorough analysis of the stages of the projects, the interactions of the stages, the allocation of resources to the stages, and how and when deliverables would be produced.
2. A group oral report including a presentation of the software design, implementation and testing. This was marked for a design that matched the requirements, for code that matched the design, for a working product that was verified and validated, and for a reflective analysis of the group collaboration during the project.
3. An individual written report including similar points as the group oral report, but presented from an individual perspective. The written report was to include a reflection on the efficacy of the software engineering methods used and a copy of the logbook kept during the project.

These assessments were chosen to allow the practice of Professional Skills, as well as to evaluate the processes students used in the project. Evaluation of the processes was possible in that the marker would look for: a thorough analysis rather than a specific plan (in the project plan assignment); traceability in the stages of the software lifecycle (in the oral report), because this would imply that software engineering methodologies had been employed; student evaluation of their own methods of working and collaborating with group members (in both the oral report and the written report), because this would reveal the extent to which students understood and tried to employ good practice and the extent to which they collaborated effectively.

In 2007-08, groups were selected alphabetically, with no particular attention paid to previous strengths or weakness, or to friendship groups. It is worth noting that although each student had knowledge of programming from first year modules, the level of confidence with programming differed widely. To balance the abilities in the groups better, in 2008-09, groups were selected based on marks in the previous year's programming modules, with each group of three comprising one each from students with relatively high, medium and low marks. Each group of two comprised two students with relatively medium marks.

During the design process, groups identified and decided on a hierarchical structure for programming modules, and divided the implementation amongst group members. This assignment of programming tasks to individuals paralleled the resource allocation in the Gantt Chart produced in the group project plan.

4. OUTCOMES

The adherence to Software Engineering methods was high; the standard of software implemented was good, and the engagement with Professional Skills was very positive. All groups delivered the final product as specified, but none completed it with time to spare. All groups were able to trace their implementation to their design, and to the requirements they had been given.

The students showed great enthusiasm for the project, with all attending and working steadily with their groups. Marks achieved for the module were all upper second or first class marks. Typical statements in the reflective element of their reports were

- "I feel I have learned a lot from this project, going through the entire software design process allowed me to understand the importance of having a structured approach to designing a piece of code."
- "At the start of the module, I was quite prepared to simply start coding without really thinking about the structure of the program and how the different functions would fit together. I dread to think how the final program would have turned out if I had done so. By designing the system extensively before beginning work, a lot of time was saved and potential problems avoided. ... I do not particularly enjoy the large amount of paperwork needed before a project is undertaken, but I can clearly see its value, and hopefully this is reflected in the quality of my final program."

In 2007-08, for one of the three groups the division of labour chosen by the group worked well, but for two groups there were significant differences in ability, which caused some resentment amongst group members. Even for the group which worked well together, there was an angry interchange when it was discovered that the interface to a program module had not been implemented as assumed hence one student had to make significant changes to a programming module: this was a good object lesson in the importance of agreeing module interfaces at the outset. In 2008-09, ability differences did not cause resentment despite the fact that these groups had been specifically assembled to have a mix of proficiencies, but personality differences and different approaches to working did cause problems: in one group there was a disagreement about the algorithm to use in decoding which caused significant resentment. In each group in each year, members who finished their own tasks early offered help to members struggling with tasks; this corresponded well with the PBL ethos of self and peer evaluation and collaboration.

Student feedback at the end of the module included these statements:

- "I enjoyed the opportunity to practice my C code on a larger scale than any previous modules. I found the handouts very clear and useful in completing the assignments. Also, I feel like I learned a lot (C programming ability, general business skills) without having to deal with an unreasonable workload. ... I was pleased with how little time was spent on lecturing and how we were allowed to get straight into the project after a week."
- "something different ... freedom to do what you like not follow strict guidelines to meet requirements".
- "Good team work exercise, a good opportunity to refresh on programming skills."
- "I don't believe the groups were very well balanced, which made the project much harder work than it might have been."
- "<module name> has improved my ability to manage a group and my ability to break down a problem and create a solution. It also provided needed practice with oral presentations, something rarely included within other modules.... The management elements of the module are integral to any programming project, and as such are important parts of the course as a whole."

5. ONE YEAR LATER

Some of the second year students who did this project in 2007-08 went on to do a group design project in their third year in 2008-09. This group design project again necessitated project planning, team work, requirements management and software development. There were other students on this third module also, who had taken a second year Software Engineering module taught mainly theoretically with a small individual project, and a second year Laboratory module which included various small group hardware+software projects. None of the students will have taken all three of the second year modules: each second year student took either the PBL Group Project Module, or Software Engineering and the Laboratory Module. At the end of the third year project, students were asked about the skills they felt they had gained from various modules **before** starting their third year. Figure 1 shows the number of students who felt they had gained skills, expressed as a percentage of those who took the module.

| Skills acquired | PBL Group Project Module | Software Engineering Module | Laboratory Module |
|---|--------------------------|-----------------------------|-------------------|
| Planning and managing a group project. | 75% | n/a (no group project) | 33% |
| Working in a group | 50% | n/a (no group project) | 30% |
| Analysing and recording system requirements | 100% | 100% | 22% |
| Designing software | 60% | 63% | 63% |
| Writing software | 75% | 55% | 66% |
| Verifying and validating a system | 75% | 55% | 75% |

Figure 1. Where students felt they had acquired skills

The answers the students gave appear to show that those who took the PBL Group Project module felt they developed software engineering and professional skills through this module, more than did the students through other modules which have some of the same desired learning outcomes.

6. CONCLUSIONS

The aim of this project was to embed the discipline of Software Engineering in the discipline of Professional Skills as would be done in a workplace environment, at the same time enhancing learning by implicitly emphasising the similarities between the disciplines. The group PBL medium was well suited to meet this aim, because it made the module more interesting to students such that they engaged with theory that students tend to find tedious, and because group PBL is a realistic way of working as a continuing professional.

A limitation of this project was that there was insufficient time to expose students to the entire, broad range of Software Engineering and Professional Skills. It is hoped that the project gave sufficient practice to make automatic a limited range of Software Engineering and Professional Skills, and also equipped students with the ability to discover new areas and techniques for themselves.

This project had the advantage of a small class size, nevertheless some of the learning and teaching techniques used will scale up for larger classes. Therefore, the impact of the project has been to cause the department to reconsider its approach to the teaching of Software Engineering, with a view to reinforcing theoretical knowledge with groupwork and Problem Based Learning.

Students' feedback, along with their reflection in the oral and written reports, indicates that they recognized the value of a methodology in software development, and that they had appreciated the need for professional skills as well as programming skills in order to create good software. It was very useful to question students one year later, and to discover that skill acquisition with the PBL group project module was felt to be slightly greater than for students taking other relevant modules. It seems likely that two key factors in the success of the group PBL project were 1) enabling students to experience software engineering, i.e. to learn by doing and 2) assessments which emphasized process and skill application over an end product. This contrasts with other relevant modules, which emphasize either theory or an end product over good practice. An emphasis on process and application of skills appears to have benefitted the students.

7. ACKNOWLEDGEMENTS

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USING VIDEO LOGS FOR REFLECTION: EXPERIENCES WITH A NEW APPROACH TO TEACHING USABILITY TESTING

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ABSTRACT

In this paper we share our experiences and preliminary results of an ongoing Higher Education Academy funded project. The project was affectionately known as the EVIL project (Experiential Video Logs for usability testing), and focused on the creation of video logs of students' usability tests. Students were required to design and implement usability tests in the Department's usability lab, making a video record of the test, that was used to facilitate personal and class reflection activities. Students engaged in an iterative process of test design, implementation and reflection, feeding the results of the reflections into subsequent test designs. Student feedback indicates that the project had an extremely positive impact on the students' learning experience, and their understanding of usability testing. The sharing of video files in class was popular with students and was a useful vehicle for the introduction of new ideas.

Keywords

Usability Testing, Video Logs, Reflection, Experiential Learning, Human-Computer Interaction.

1. INTRODUCTION

Standard classroom-based approaches to the teaching of Usability Evaluation Methods (UEMs) may help students learn methodological principles, but they do not easily communicate the requisite experience-based knowledge, that enables usability methods to be effectively implemented and tailored. Indeed, research in UEMs has shown that methodological principles can be interpreted in a variety of ways. For example, a study which compared 9 usability tests of the same product, conducted by 9 independent organisations, found huge variations in both the testing process, and the quality of the test results [3]. Research also suggests that the usefulness of a UEM is bound to the strength of evaluator's own experiences [2]. The challenge for UEM education therefore, is to facilitate the development of this experience-based knowledge in our students. One solution is to use video demonstrations of methods in action, as these may give students valuable context. However a more innovative approach would be for students to develop videos of their own tests. Learning could then be consolidated through a process of personal and group reflection.

The aim of this project was to investigate the use of video logs to promote student reflection and learning of Usability Testing Methods. Specifically, students were asked to develop and run a number of pilot usability tests, as part of their normal class activities. Video recordings of the tests were made and used for both personal and shared class reflection; students used their reflections to improve subsequent test design. Assessed work required students to write an individual evaluation of the tests as recorded in the video logs.

The remainder of this paper describes how the video logs were used to support teaching and learning and presents some preliminary results on the impact of the process on the student experience.

2. TEACHING AND LEARNING CONTEXT

The project ran within a final year undergraduate module on Human-Computer Interaction. There were 47 students enrolled on the module, 31 home/EU students and 16 international students. Students were registered on one of the following degree programmes: Multimedia Computing, Applied Business Computing, and Computer Applications. The module consisted of two hours formal contact time per week; this was used in a workshop format with brief lectures and extensive practical work. The module ran over three terms, starting in September 2008; the project timeline was between December 2008 and July 2009.

3. PROJECT OPERATION

Working in groups, students were required to engage in 3 iterative activities: Usability Test Design, Test Implementation, and Test Reflection. Group work was necessary, as usability testing is a team-based activity, where individuals can be asked to perform a number of different roles (e.g., administrator, coder, recruiter). Twelve student selected groups were formed with a maximum of 4 students per group.

3.1 Usability Test Design

A small number of workshops were held on Usability Testing covering test goal design, test user selection, task design and usability measures; during these workshops students began to design their tests. Class time was then divided between test design activities and test reflection. As the project progressed video log reflection became the dominant activity, and the primary vehicle for teaching new material.

Students worked with 4 test scenarios; these detailed the software on which the tests would focus. General concerns and broad user groups were identified so that students would gain experience in narrowing them to specific goals and identifying appropriate user sub-groups. The use of very specific scenarios would not have given students the required scope to make decisions about the goals and focus of each test, thereby limiting their learning experience.

Two websites were selected (<http://www.sunderland.ac.uk> and <http://www.sunderland.gov.uk/>) and two applications (Google Mail and PowerPoint). The mix of software allowed for a richer testing experience as students would need to consider developing test materials for the applications and measures of navigation for the websites. The software choices also meant that access to representative users would not be difficult. Students were required to conduct at least 2 tests on their chosen software, as this would demonstrate the impact of their reflection within the design and implementation of the second test. 5 out of the 12 groups worked with only 1 piece of software, continually refining their tests, the remaining 7 groups worked with 2 or more software choices to broaden their experience.

For each test, students were required to prepare test design documents, detailing the specific goals and concerns of the test, test user group, test procedure, tasks set, usability measures and any test materials (e.g. test emails, account creation, slides, questionnaires).

3.2 Test Implementation

Tests were held in our Usability Laboratory. The laboratory consists of two rooms; a participant room where the test user is accommodated, and an observation cell, occupied by the test team. There is a one-way mirror between the two rooms, and a number of wall mounted video cameras in the participant room. The test participant's screen was recorded using TechSmith Morae (See Figure 1).

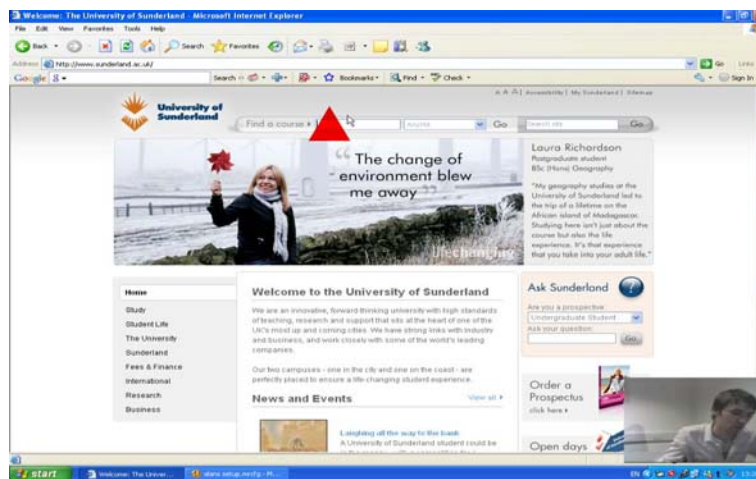


Figure 1: Video still of a TechSmith Morae file

During each test, one student acted as the test administrator, and worked with the test user; the remainder of the group watched the test from the observation cell, making notes and identifying usability issues. Students were encouraged to swap roles for each test, so that they would experience the tests from different perspectives. All test participants were fully briefed, and gave written consent for the sessions to be video recorded. Students recruited their own test participants, and tested one person per usability test.

After the test, students were given 2 digital video files: a TechSmith Morae file illustrated in Figure 1, showing the test participant's screen with mouse clicks highlighted (as indicated by the triangle), and a webcam image of the participant. The second file taken from the laboratory cameras showed the participant room (Figure 2).

Students were encouraged to discuss the tests immediately after each session in their individual groups and to use the videos for subsequent reflection.



Figure 2: Video still from the laboratory camera

3.3 Reflection

Students were encouraged to reflect on the strengths and weaknesses of their usability tests, in order to make subsequent improvements to their test design, procedure and materials. To ensure that students were comfortable with reflection a number of practice exercises were conducted in class. To facilitate the reflective process, students were asked to consider:

- Interactions with test users: the use of verbal prompts, instructions, and questioning.
- Task Set: the appropriateness and structure of the tasks used. For example, user task match, task order.
- Materials: the appropriateness and utility of any test materials used.
- Usability Measures: the appropriateness and relevance of the usability measures (e.g. questionnaire responses, think alouds, performance measures).
- Team Roles: how well each individual performed their role within the test.
- Usability Problem Extraction: the extent to which the test confidently revealed usability issues.

Using these categories students were asked to reflect using the four different methods described below.

- Guided Reflection: The authors attended the first lab test conducted by each group, and participated as active observers. Their primary role was to prompt reflection by asking focused questions of the student observers. They also facilitated a reflective discussion with the group about the process and outcomes of the test after the session.
- Group Reflection: Students discussed the process and outcomes of the test immediately after the testing session, within their own team group.
- Shared Reflection: Highlight videos for each test were prepared by the first author and these were shown during class time, students then shared and discussed their reflections of the test with each other. Students reflected on their own tests and those of students in other groups.
- Self Reflection: Students watched the videos and wrote reflective notes about the test, this was an individual activity, using the framework presented above.

4. PROJECT EVALUATION

The student learning experience was evaluated in a number of ways. Module feedback was taken using the Nominal Group Technique; a questionnaire was designed and completed by a sample of 35 students; this focused on understanding student reaction to: the use of video logs for learning, their experiences in the usability lab, the use of group work, and use of reflection. The repertory grid approach was used in order to gain insight into how students individually construed the learning experience. The type of grid used was a partial grid [1], where the elements (Teaching and Learning approaches) were provided, and the constructs were elicited from participants. These results will be available by July 2009 as data collection is ongoing at the time of writing. Student learning will also be evaluated through student assignments in July 2009.

5. RESULTS

The results reported here represent a small section of the questionnaire data, and focus on the students' experiences of reflection using the video logs.

a. Attitudes to Reflection

During the evaluation students were asked about their thoughts on the process of watching videos in class and sharing reflections. Students were asked to indicate the extent to which they found the process to be: Fun, Interesting, Embarrassing, Insightful, and Respectful. Responses were made on a 5-point scale where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree". Figure 3 presents the mean response for each statement.

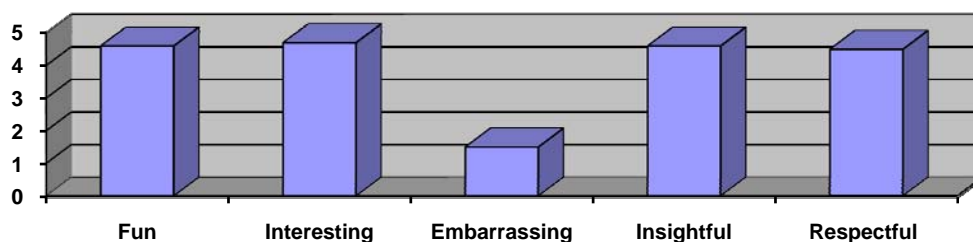


Figure 3: Mean ratings on the use of Shared Video Reflections

Students indicated that shared reflections provided a good experience, it was fun, interesting, and beneficial in terms of thinking about how to reflect. The low mean rating for embarrassment indicates that in the main, students were not uncomfortable. Two students did indicate that they would have preferred their first test not to be viewed as they were "novices and made mistakes". However, the point of the process was to learn from experience and making mistakes is part of that process. Interestingly, the same students also indicated that they had learned a lot from the mistakes made by other students. The high ratings for respect indicate that students believed that the process of reflection was carried out in a constructive way.

A number of students expressed concerns about the use of reflection and reflective writing as they had had little experience of this process. Reflection was facilitated using the 4 different approaches outlined in section 3.3. To understand which type of reflection was most helpful, students were asked to rate each type on a 5 point scale ranging from 1: Not at all helpful to 5: Extremely helpful. The mean rating for each type of reflection method is depicted in Figure 4.

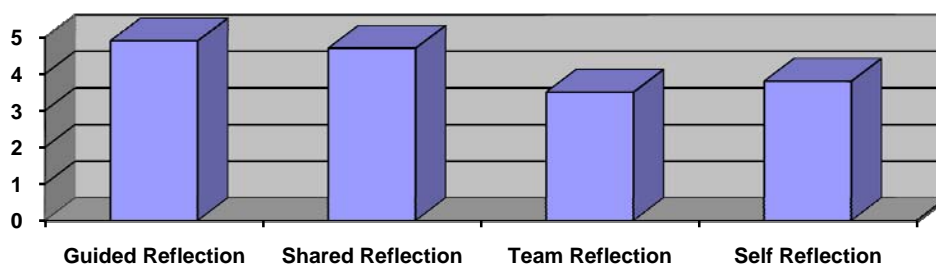


Figure 4: Mean ratings on the usefulness of reflection methods

The results indicate that students believed the guided and shared reflection to be most useful, followed by self reflection. Team reflection was given the lowest rating for usefulness; students indicated a variety of reasons for this, ranging from "being caught up in the moment"; "too excited"; "too much to take in" to "having to go to another class". All students, who have responded to the questionnaire at this point, have indicated that the video logs were the best method for reflection, as they allowed the space and time to be more objective.

Students were also asked to indicate the extent to which the methods helped them to understand the impact of their test design; inspired them to try new approaches in the construction of their tests and test materials; and finally which method led to more tangible changes in how they approached their next test. Students rated the reflection methods on a 5-point scale ranging from 1: "Little Help" and 5: "Extremely Helpful". Figure 5 shows the mean ratings for each method.

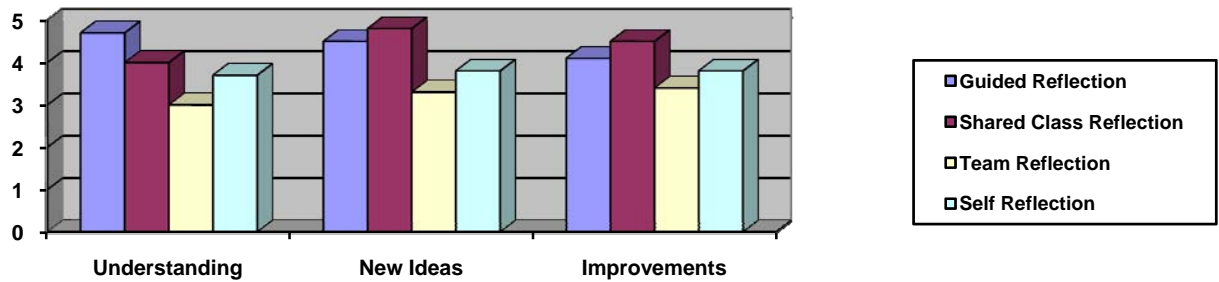


Figure 5: Mean ratings for reflection method impact

The results showed that in terms of understanding design impact, guided reflection was most useful. This is probably because it was done first and served to focus subsequent reflections. Many students reported that without it, they would not have gained as much from the experience. Interestingly though, they were keen that all subsequent tests were run without guided reflection, so that they could develop independently. Shared reflection was also rated highly for understanding design impact because different students would notice different things and provide different insights; this is consistent with commercial practice where multiple evaluators are used [2]. Shared reflection was most useful in terms of generating new ideas and test improvements. Students learned from one another and were able to see how other people approached the same topic. Students indicated that they had learned from their own mistakes, but also the good practice of others. The ratings for team reflection were the lowest for each category, probably for the reasons described above. Self reflection was rated below Guided and Shared reflection, this may be related to the fact that Self reflection, in the main was engaged in after the other types of reflection, meaning that students may not have consciously recognised their own reflective input to the previous sessions when completing the questionnaire.

6. DISCUSSION AND CONCLUSIONS

Student feedback indicated that the project had been a resounding success in terms of providing an engaging and informative learning experience. Student comments suggests that they found their use of the laboratory to be fun and interesting, and that they believed the project gave them a more realistic experience of what usability testing is about, and also afforded them the opportunity to demonstrate their skills in concrete way, that could be attractive to future employers. One student commented that it was “the best learning experience of their university career.” Negative comments received related to the number of contact hours in class. Students indicated that they believed the 2 hour contact session was too short, and would have like it to be extended. From a staff perspective, the project was immensely satisfying; student engagement was excellent; the project created a real buzz across the final year students who were involved. The use of highlight videos for shared reflection, was a time consuming process in that videos had to be watched and then edited, however, it was clear from the reflective comments made by students week-by-week, that their skills as reflective practitioners were maturing, and their usability tests were improving to an extent, that the teaching team had not observed in previous iterations of the Level 3 Human Computer Interaction module.

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INFORMATION LITERACY RESOURCE BANK: LEARNING OBJECTS FOR ACADEMIC SKILLS DEVELOPMENT

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ABSTRACT

The Information Literacy Resource Bank (ILRB) at <http://ilrb.cf.ac.uk>, has been developed by Information Services at Cardiff University to provide innovative, interesting and interactive learning resources for staff to incorporate into their teaching materials to enhance student information literacy. Each learning object is bite-sized and highly re-usable within any discipline, and most can be adapted for use in both e-learning and printed materials. Staff plug their favourite resources into handouts and PowerPoint slides, link to them or download them into Blackboard.

Interactive exercises, quizzes, cartoons, diagrams, animated sequences and podcasts are all available. Topics include avoiding plagiarism, citing and referencing, evaluating information and search techniques amongst others. Learning objects on a theme have been brought together into short tutorials to support students at the point of need. These short tutorials include citing and referencing in each of four bibliographic formatting styles, avoiding plagiarism, reading research critically and EndNote.

Resources from the ILRB are in use in over half of all Schools in Cardiff University. They have also been re-used or re-purposed by many other institutions in the UK and overseas.

The majority of the learning objects in the ILRB are openly accessible to anyone on the web. Only those cartoons and videos which we use under licence from others are password-protected. Branding has been kept to a minimum to aid re-use. If you wish to use the ILRB, we ask only that Cardiff University is acknowledged, and that you let us know how you intend to use the resource.

The poster will include examples of the bite-sized learning objects and feedback from students and from staff in Cardiff University and other institutions.

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TOWARDS A PERSONAL DEVELOPMENT PLAN FOR ICS STUDENTS ENTERING THE CREATIVE INDUSTRIES

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ABSTRACT

There is a particular need for ICS students seeking employment within the creative industries to understand that a balance of transferable and subject-specific design and technical skills is required for employability. In the creative industries, ICT is characterised by a proliferating skill-set and rapidly changing operational definitions. In addition, the traditional disciplinary boundaries are disappearing in favour of a more flexible curriculum. This can be confusing for students who must plan their skill acquisition and ensure their skills are explicit and recordable for future employment. The Placement Pitch project intends to examine how students can be encouraged to diagnose their personal skills gaps and to take action to improve their chances of employability within the creative industries. We shall present a web-based social networking system that intends to support students in this effort. During the poster session, we shall highlight examples of video submissions from students and podcasts from potential employers, and we shall outline the managerial issues that arose when applying the system across different schools at the University of Dundee.

Keywords

PDP, Employer Engagement, Collaborative Social Networking

1. THE PLACEMENT PITCH PROJECT

Placement Pitch is a prototype social networking system based upon the Joomla content management system [1]. As is typical of Web 2.0 products, it depends upon critical mass of use to develop content. We have adopted a typical technology innovation lifecycle for the product, in which the design and build are updated and released regularly to early adopters for testing. This release contains content to support learning about the creative industries and technical industries. The system contains learning units that support the development of a public facing outcome: a web-based CV and a directed portfolio of work. Students are provided with an internally facing workspace where they can develop their ideas, planning documents and share them with their Placement Pitch community. There is an area devoted to peer learning encouraging students to seek help from other student groups, alumni employed within the creative industries and industrial consultant partners.

The overall aim of this project is to investigate the extent to which personal development planning can be incorporated into ICS curricula. Secondly, the project aims to develop in students an awareness of the significance of transferable skills relating to employability within the creative industries. The project also aims to develop in students an awareness of the distinction between, and significance of, transient skills and enduring skills. The application will develop an ICS version of the T-skills model known to industry [2] – broad general skills together with deep specialist skills – which will improve students self-marketing. The final aim is to promote the use of a range of activities that encourage a reflective approach to learning.

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3. ACKNOWLEDGEMENTS

This work is funded by the HEA ICS Subject Centre through their Development Fund. Thanks are also due to the contributors (students and employers) to the prototype system.

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EVALUATION OF SELF AND PEER ASSESSMENT IN PROMOTING GROUP RESPONSIBILITY AND INDIVIDUAL INVOLVEMENT

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ABSTRACT

It has become an essential requirement for students to work in a team setting and participate in group activities to achieve team goals. However, the ability to manage and monitor group projects in large student cohorts presents an enormous workload, more over, issues such as, how to encourage group activities and how to assess individual contribution in the group work are of challenging. This research applied self and peer assessment in student group coursework assessment to promote group responsibility and individual involvement.

Keywords

Group work, peer assessment, group assessment

1. INTRODUCTION

It has become an essential requirement for students to work in a team setting and participate in group activities to achieve team goals. Group assignment has the advantages of training students the teamwork skill and the skill of undertaking a larger project. However, the ability to manage and monitor group projects in large student cohorts presents an enormous workload [1], more over, issues such as, how to encourage group activities and how to assess individual contribution in the group work are of challenging. This research aims to promote group responsibility and individual involvements in group course work.

2. METHODOLOGY

The module in this research was undertaken was a 20 credit, level 2 programming module in the BSc (Hons) interactive multimedia design(IMD) and the BSc (Hons) information communication technology(ICT). The student cohort numbered 170 in total in 2008/2009, and the student group was diverse in terms of programming skills and interests. The students also live over a wide geographical area in Northern Ireland. The module assessment was 100% coursework. The coursework was divided into one individual coursework(20%) and two pieces of group coursework (80%).

To ensure a fair assessment, standardised assessing criteria are important but not enough for group assignment. Students in the same group can contribute differently to the coursework and the assessment has to take this into account. Given the large size of the class, an online system *Magic*[1] was applied in this case study. Students are required to record meeting minutes, task allocations and implementation results. Self assessment of contribution to the group and peer assessment of other members' contribution were carried out anonymous after the submission of the coursework. When the self assessment was different from the peer assessment from other group members, an interview was held between the student and me to discuss the assessment. The deduction was taken or the bonus was rewarded according to the assessment.

3. OBSERVATION AND SUMMARY

Each group kept the meeting minutes and group logbook. The self assessment and peer assessment reports received reflected fair assessment of group contributions. Three students were interviewed for being marked down by other members as inadequate involvements. This case study has demonstrated that the self and peer assessment approach can promote group responsibility and individual involvement, as students were aware that their individual contribution would be fairly assessed.

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AN EXAMINATION OF THE CAUSALITY OF TRANSITION AND RETENTION FAILURE WITHIN COMPUTER SCIENCE BASED COURSES

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ABSTRACT

A significant number of studies have been conducted with the specific aim of formulating generic strategies to enhance student transition and retention [1, 2]. Far fewer studies have been carried out into the causality of transition and retention failure within computer science based courses. This work aims to explore the reasons why students specifically studying computing based courses may find transition into higher education difficult and ultimately highlight the causes of retention failure within the field. The work attempts to evaluate the benefit of the traditionally proposed transition and retention guidelines when applied to computing courses and where appropriate makes subject specific recommendations to enhance transition and retention within the field.

Keywords

Student Transitions, Retention, Computing

1. INTRODUCTION

A significant body of work has been produced with the specific aim of improving student transition and retention. Unfortunately, much of the work produced thus far has been based around observation and experimentation within courses other than computing. As it is probable that the personal characteristics/learning styles of students opting to take computing based courses are likely to be different from those taking non-computing based courses, research in to effective transition and retention strategies for computing courses would seem justified. To this end, the following aims and objectives for the work were formulated; (1) identification of the cause of transition and retention failure for computer based courses; (2) evaluation of the generic strategies for transition and retention as applied to computer based courses; (3) formulation of a set of computing course specific transition and retention enhancement guidelines.

2. APPROACH

An on-going battery of student evaluation interviews and questionnaires are being utilised with students who have been identified as experiencing transition or progression difficulties. Candid interviews, focusing on the student's transitional experiences and their perception of their own personal reasons for apparent failure within the course are explored

3. RESULTS AND CONCLUSIONS

Preliminary results suggest that generic strategies for transition and retention enhancement are appropriate for computing based courses, however the nature of the material taught within the field of computing (e.g. programming, logic, mathematics, etc.) and the personality tendencies (e.g. preferred learning style) of many students drawn to computing, may necessitate field specific strategies for induction, curriculum development and staff development.

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PEER ASSESSMENT OF GROUP WORK IN COMPUTING USING WEBPA

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ABSTRACT

This poster reports on some of the issues in carrying out peer assessment of group work, and in particular report on the use of WebPA – an open source peer assessment tool to allow the online submission of peer marks by group members, and the management of the process by the teaching staff.

Keywords

Peer Assessment; online tools; technology enhanced learning.

1. INTRODUCTION AND RATIONALE

Group and team work are considered as key parts of the Higher Education computing curriculum [1], [3]. One aspect of the inclusion of such content in undergraduate courses is how to assess it. Peer assessment of the contribution of group members can be an effective way of doing this [2]; however, managing the process and encouraging engagement by all of the students within a large class can be a challenge. In this poster we will report on some of the experiences of using the free and open-source peer assessment tool WebPA in order to support this activity.

2. SOME OF THE ISSUES

Challenges for peer and self assessment: Suitability of the assessment; Fairness in the marking process; Transparency in marking criteria and Practical management issues in handling multiple marks for individuals.

3. WEBPA: A TOOL FOR PEER ASSESSMENT

WebPA provides a tool to automate much of the process with regards to peer (and self) assessment. It allows groups to be set up, and for students to assess their other team members; it implements a simple algorithm to allocate a weighted mark and it provides for students to enter marks in a faceless environment. It also deals with some of the practical management issues; arranging to collect and then use the data becomes a problem with large classes (e.g. >100) whereas tools such as WebPA can manage this process in an automated way.

4. CASE STUDIES

The poster will report on experiences of using WebPA – both staff and student views.

5. CONCLUSIONS

Group work is a key feature of the professional skills expected of computing graduates. Peer assessment can be a useful tool in encouraging students to engage with group work. Technologies can assist in supporting group work and colleagues may find the information on WebPA encourages them to trial and use this system.

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- [2] Gordon, N., Group Work in Higher Education Computing Courses, In Proceedings of the 9th Annual Conference of the Higher Education Academy subject centre for Information and Computer Sciences, Liverpool, pp35-39 (2008).
- [3] Quality Assurance Agency, Computing Benchmark 2007, <http://www.qaa.ac.uk/academicinfrastructure/benchmark/statements/Computing07.pdf>

MANY HANDS OR TOO MANY COOKS? GROUP EFFECTIVENESS AND LEARNING WITH MULTI-TOUCH

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ABSTRACT

This poster provides an overview of how a multi-touch based UML environment affects group dynamics in group design exercises when compared to a similar single-touch set up. The differences in the subjects' observed activities and feedback after using both systems are evaluated to determine whether the differences in interactions lead to differences in group effectiveness and how this might impact individuals' learning experiences.

Keywords

Multi-touch, groups, collaboration, design, UML

1. INTRODUCTION

Allowing students to collaborate on projects encourages them to discuss their knowledge with each other, improving their understanding of the subject area by examining their own comprehension of ideas from different perspectives. It can also improve their interaction and team work skills, which are essential in many careers today. However, this depends on whether the group can work effectively together. While this is partly determined by the individuals that make up the group, in Computer Supported Collaborative Learning the hardware involved also plays a major role in determining the effectiveness of a group.

The poster presented discusses the possible differences in group effectiveness, and hence the individual learning experiences of the group members, between groups using multi-touch capable screens and single-touch screens by analysing the communications between the group members and their interactions with the hardware/software.

2. OVERVIEW OF INVESTIGATION

A UML application has been developed to allow groups of four undergraduates to create simple class diagrams for the purpose of observing how they interact using both a single-touch and a multi-touch screen. From this the level of positive interdependence between group members, types of communication between group members, how decisions are made, and power distribution throughout the group will be observed to determine the group's effectiveness and the individuals' learning experiences.

The multi-touch system allows for simultaneous usage, and can thus lead to group members interacting more freely with each others' work without having to gain or relinquish control of the screen as they would have to with the single-touch screen. This could lead to improved sharing of knowledge and ideas; however it is possible that it could instead be seen as interfering with each others work. Similarly, rather than all users joining in with the work simultaneously the group members could end up adopting a turn based approach with the multi-touch system as with the single-touch system.

3. RESULTS

Quantitative and qualitative data is obtained through the use of video observations, coding of interactions and questionnaire responses from participants randomly selected from the level 1 programming course at Durham. The results are evaluated and triangulated to determine whether the group members worked more effectively together and whether their own perceived learning experiences were greater in one intervention over the other. The results will be included in the poster presentation.

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POWER-POINT, BUT WHAT ELSE?

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ABSTRACT

In this poster alternatives to Power-point alone with were considered. Example of student work will be presented as will tutor reflections.

Keywords

First year, presenting.

1. INTRODUCTION

Student work from tasks in two first-year modules will be presented, concern with how they presented material to a group. Though they were allowed to use power-point and many did they were also made aware of other tools they could use such as PhotoStory3 and MovieMaker and several adopted those.

The first task comes from a module concerned with problem-solving and they had to discuss how they solved the problem of controlling a robot for a set task. The dynamic and visual nature meant that many include video of the robot moving, but others took it further and the whole presentation was a movie.

The second was a task of describing number representation to a 15-year. Several of the students decided to present this in a movie form. Examples of these will be shown. An example of Machinima will also be presented.

Reflections on the strengths and weaknesses of this approach, and marking these from an assessor point of view will be discussed.

FOLKSONOMIES OF FEEDBACK: TAGGING SOURCE CODE

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ABSTRACT

This poster introduces an investigation into the effects of changing how source code in programming assignments is assessed and how the resulting feedback is generated. We investigate how source code can be annotated using folksonomy style tags as a mechanism for generating meaningful feedback for students. In this poster we introduce the project and give an overview of the results that are starting to emerge.

Keywords

Programming, Assessment, Feedback, Folksonomy, Web 2.0

1. INTRODUCTION

The teaching of programming is recognised as a difficult undertaking throughout the discipline and it is argued that good feedback is important for improving student understanding and overall achievement. It is also clear that some methods of assessing source code can generate feedback that is both ambiguous and lacking in context.

The poster introduces an investigation into how we can improve the teaching of programming by altering how assessment feedback is both generated and disseminated to students. The novel feedback system being developed utilises ideas from folksonomies, the popular Web 2.0 tagging paradigm as a method of assessing and generating feedback for students.

2. PROJECT OUTLINE

The project will focus on the identifying the degree to which folksonomies are a useful mechanism for generating feedback on student developed source code. It will further investigate what tags are used by assessors and whether or not students opt to share their feedback with peers. A plug-in has already been developed for the Eclipse Integrated Development Environment (IDE) to enable teaching staff to annotate student code with feedback tags. These tags are to be provided as part of the feedback for the assessment and are to be made available online.

A key benefit of this system is that students would be able to view their feedback tags and then be presented with the associated code fragments in the context of their project. Furthermore other fragments annotated with the same tags in the work of their peers could be displayed giving the student a wider context of their feedback.

3. RESULTS

Results will be collected using quantitative and qualitative techniques, including recording usage data from the software, questionnaires to students and assessors as well as analysis of tags and code fragments for patterns in feedback across the cohort. It is anticipated that the system will be evaluated with both level 1 introductory programming assignments and the level 2 software engineering group project. Preliminary Results are expected in May 2009 and will be included in the poster presentation.

EMBEDDING ETHICS IN COMPUTING

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ABSTRACT

Ethical issues abound in Computing. Few would argue that they are not important, and their importance will only increase as computing permeates more and more aspects of everyday life.

Professionals working in computing should always be aware of the ethical aspects of what they do. Students, who will become these professionals, should accordingly be introduced into a culture of considering ethics from the earliest stage of their education.

This workshop and accompanying poster will share the methods and outcomes of a joint initiative to embed ethical issues into various parts of a computing curriculum.

Keywords

Ethics, professional issues, professional development.

1. INTRODUCTION

Ethical issues are important, but it is sometimes difficult to convince students of this. Too often students are carried away with the exciting technology and forget to consider the more social aspects of what they are doing.

One approach to introducing ethical issues is to embed them within modules covering “hard” technical topics. This approach places the ethics firmly in context and can be used to challenge the students to think about the social issues surrounding the rest of their studies.

2. INITIATIVE

The IDEA (Inter-Disciplinary Ethics Applied) CETL [1] is a Centre for Excellence in Teaching and Learning at the University of Leeds. The Centre has been working with the School of Computing to embed ethical issues in the curriculum in a number of ways. These include:

- Ethical issues in teamworking: dealing with defaulters, allocating tasks.
- Ethical issues in AI: can machines be alive, and if so is it ethical to switch them off?
- Ethical issues in the use of Open Source software: is it ethical to use the freely given work of others for profit?

3. WORKSHOP AND POSTER

In the Workshop session we will briefly present those attending with the rationale for embedding ethical issues within the curriculum. Then we will work through one or more of the sessions that have been developed, engaging those present in similar discussions to those we have had with students.

The accompanying poster will again present the rationale and will also pose the ethical questions from the various sessions.

4. REFERENCE

[1] IDEA CETL, <http://www.idea.leeds.ac.uk/>.

TEACHING COMPUTING IN A VIRTUAL WORLD: PRINCIPLES AND PRACTICE

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ABSTRACT

In this poster and workshop we describe work underway using the virtual world Second Life to support teaching of the Open University level 1 computing course T175: Living in a Networked World. The poster will describe work to date, with screenshots and key findings so far. The workshop will provide participants with a snapshot experience as a student on T175 – attending an induction session and then visiting one of the inworld resources built to support the course, with time at the end for discussion to capture reflections and answer questions.

Keywords

Second Life, virtual worlds, blended learning, distance support

1. INTRODUCTION

T175, Networked Living: Exploring Information and Communication Technologies is a 30 credit Open University course at level 1 that is presented twice a year. The course description can be found at <http://www3.open.ac.uk/courses/bin/p12.dll?C01t175>. This is a compulsory course in our Certificate in Information Technology and Computing, BSc (Hons) Information and Communication Technologies, BSc (Hons) Computing with Business and BSc (Hons) Computing and Systems Practice among others.

The course is divided into four blocks and is supported through online forum activities on a tutorial and national scale, and through a small number of face-to-face local tutorials, which are historically poorly attended. In the last 2 years three tutor groups have been supported by replacing the face-to-face tutorials with meetings in the virtual world Second Life, with excellent results for retention, and 'taster' Second Life tutorials have been offered coursewide. Last year a two-day course festival was held in Second Life.

The 2009 development of this project builds on our experience and understanding of how we can use Second Life to support student's engagement and learning. We are creating a series of working models to illustrate 2 core concepts from each of three blocks of the course, e.g. the first model is a working RFID subway system. These models are/will be available for the students to explore at their leisure for a limited period of 2 weeks, and are/will be followed up with an open discussion within Second Life.

It is anticipated that the Second Life activity will provide richness by developing the course material into working models, engaging students to support their learning and understanding of key concepts and consequently aiding student retention. The course models can be re-versioned and re-used indefinitely for future presentations of the course.

The poster for this session will describe the project and show screenshots and reflections on work completed to date.

The workshop for this session will enable participants to experience an induction activity, as provided for T175 students, and to explore an inworld resource. Participants will need to have registered with Second Life and set up an account in advance of the workshop, and the workshop will require a sufficient number of computers with the Second Life client installed and tested against firewalls etc. There will be two facilitators to provide guidance and support, and one facilitator present in Second Life. At the end of the session there will be a discussion to capture reflections on experience. The facilitators manage The Open University presence in virtual worlds, and will be happy to answer general questions about working in this environment.

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AGILE & EVO INDUSTRIAL GROUP PROJECTS

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ABSTRACT

In this poster, I describe the process and preliminary results of organising industrial participation with group projects using agile and evo software development methods. Students want more industrial experience, and industry wasn't coming to us, so we went to them, and found lots of willing participants. This process should be repeatable everywhere with slight adaption to local circumstances.

Keywords

Group projects, industrial experience, agile, evo software development process.

1. INTRODUCTION

Students are more employable with some industrial experience, and they always ask if this is possible. I have started a pilot scheme with a local volunteer group, and two other organisations to provide real projects for each group on our MSc conversion courses this summer. Each team will follow standard software life cycle practices using agile and evolutionary development and delivery. Students will be introduced to the concepts via lectures and workshops on agile development, test driven development, user stories, and the benefits of version control. We also plan to have the assistance of some consultants, who will help with the workshops.

2. THE CLIENTS

We have three different clients for the teams. One client is a local volunteer organisation, who will be able to provide us with more clients in the future. A second client is a local spin-off company from the department. The third client is an open source project, which is managed by one of our advanced MSc students. These three projects will cover a range of issues that need to be resolved in this pilot project.

3. RESOURCES

Each team will have a staff member to guide them, a version control repository, a development server for continuous integration, and a room to use for meetings, and ongoing diagrams and charts. The pilot projects should also uncover any other resources, which will be needed by future teams

4. USE AGILE PLUS EVO

Given our term time limit, we need to use proven processes that deliver useful business results in the allotted time. This means using evolutionary development from Tom Gilb [1], and agile development practices, which also align well with what students encounter in most workplaces. Most importantly, it means we focus on what brings the most business value to the client for the time we have available.

5. INDUSTRIAL PARTICIPATION

All participating firms provide direct access to someone, whom the students can turn to for quick discussion about the project as needed. Agile projects require active client participation, and the firms have all agreed to this so that the students do not have to wait for issues to be discussed and decided before proceeding.

6. THE FUTURE

This is a pilot project. The poster will show early results of the summer projects. If all goes well, as is expected, then it can be integrated and extended to all undergraduate group projects. The volunteer sector has a shortage of money, and a thirst for projects. We also avoid stepping on local developer's toes, while providing a useful service to clients, and valuable experience to students.

[1] Gilb, Tom, *Competitive Engineering*. Butterworth-Heinemann (2005).

USING DRAMA TO INTRODUCE ETHICS TO TECHNOLOGY STUDENTS AND PRACTITIONERS

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ABSTRACT

In this poster we describe the use of Joe Penhall's play 'Landscape with Weapon' [1] as a resource to teach ethics to students and practitioners in technology. 'Landscape with Weapon' is a play in three acts that revolve around issues confronting an engineer who works in the weapons industry. The play raises a number of broad questions concerning intellectual property rights, duty and responsibility in professional conduct, amongst other ethical issues. Crucially, however, although the play raises 'big' questions concerning technological development, it is in the portrayal of relationships between individual characters each with their own personal ethical stance, and it is in the development of these relationships through conversations and outbursts that vital ethical questions arise.

Although it is not always clearly recognised, it is in the everyday, routine conversations and dealings of people that ethical questions are refined, developed and, on occasion, answered. Accordingly, such dialogues influence action and guide conduct. Rather than focussing on the formulation of theory, a play can demonstrate how ethical stances fare when placed alongside one another. Also, a play encourages the audience to empathise with characters thus inviting the audience to examine their own ethical positions through their reactions to the dialogue, gesture and action set out in the play script. In short, a suitable play such as 'Landscape with Weapon' can function as an allegory representing issues and questions of relevance to an audience of practitioners in a variety of areas of technology development.

This poster uses 'Landscape with Weapon' as an example of one amongst several plays and dialogues used as resources for teaching ethics in the Unit 'Introducing Ethics in Information and Computer Sciences' (working title), currently under development with the support of a grant from the HEA Subject Centre for ICS. The Unit, a self-contained multi-media course, will be made available, for re-use and re-purposing under a Creative Commons License, on the LabSpace (<http://labspace.open.ac.uk>), the experimentation site of the Open University open content initiative OpenLearn (<http://www.open.ac.uk/openlearn>).

Keywords

Ethics; professional practice; drama; rhetoric; emotions; ethical reasoning

REFERENCE

[1] Penhall, J., *Landscape with Weapon*. Methuen (2007).

USING QR CODES AS A MEANS OF PROMOTING SELF-DRIVEN, INFORMAL LEARNING IN HIGHER EDUCATION

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ABSTRACT

With the dawn of the information age comes a new role for educators to play outside the classroom. No longer are teachers and libraries the sole source of information for their students, it is available virtually anywhere and in a variety of forms. This presentation describes on-going work in the field of informal education outside the classroom, time students spend themselves exploring things that interest them in a casual and accessible fashion. Accepting that wireless internet access is becoming ubiquitous we have created an application on top of existing context-aware, wireless software which uses this high degree of connectivity combined with 2D Barcode (QRCode) 'tags' as a means of providing the learner with access to a centrally updateable repository of information about the object they are viewing. Further work utilises the user's historical actions to create a 'personal context' and adjust the user experience accordingly via recommendations and bespoke page layout.

Keywords

QR Codes, 2D Barcodes, Visual Tagging, Context-aware, Context-sensitive, Personalization

1. SOFTWARE

Our application is built on top of Technology Enhanced Campus (TEC), a context-aware application with a wide range of potential uses for university students (<http://tel1.dur.ac.uk>). The application is aware of a user's location as well as various other pieces of information such as course/year of study and gender. On launching, users see the option to Scan a 2D Barcode or receive a recommendation.

2. TALKING POINTS

The barcode scanning system is the first openly available (open source) application for Windows Mobile that scans QR Codes with minimal user interaction and compares favourably to commercial, closed-source solutions such as *I-Nigma*¹. In its construction we have used relatively low level methods to interact with the mobile device's API that will likely interest other mobile developers.

The recommendation algorithm will make up a large part of the presentation and is being submitted as part of a Masters (Msc) Thesis in September 09. The algorithm aims to create a realistic set of recommendations based on more than (but not necessarily excluding) factors like historical behaviour and physical location. Truly context-sensitive aware applications should also take the user's life circumstances into account as well as explicitly specified preferences.

There will be a chance for conference guests to interact with a prototype copy of the technology as they discuss it.

3. PILOT STUDY: PROTOCOL

The Pilot Study for this application and the recommendation algorithm will take place in and around the University of Durham Science Laboratories. Articles of interest will be labelled with QR Codes beforehand and users equipped with a device will be shown how it operates and encouraged to experiment themselves in a freeform, unrestricted time period with no obvious observer presence. This we hope will allow a true reflection of the accessibility of the technology as well as ease of use and whether or not it effectively enables Deep Informal Learning.

Results from the Pilot Study will be gathered and analysed before the end of May 2009 and will be featured in the final poster presentation.

¹ I-Nigma 2D Barcode Reader: <http://www.i-nigma.com>

AUTOMATED TRANSCRIPTION OF SPOKEN WORD LECTURE MATERIALS

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ABSTRACT

In this interactive poster session, we will describe and demonstrate (on laptop computers) the system that we have developed in order to semi-automate the process of generating transcripts of lectures, using open source and proprietary software in Windows, Linux and Mac OSX environments. The transcripts can be used to refer back to MP3 recordings of the lectures themselves.

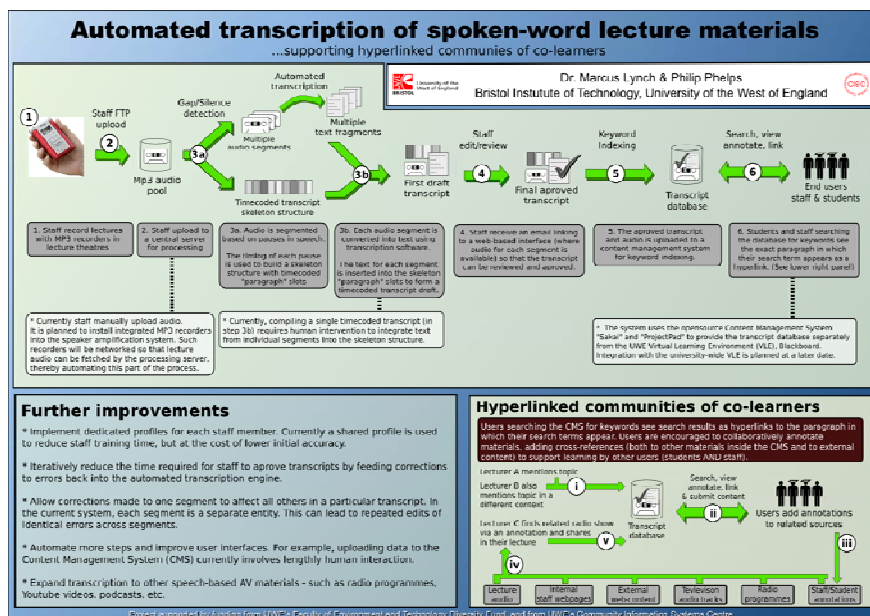
*The initial motivation for producing such transcripts was to support learning by hearing-impaired students, although we soon realised that such lecture transcripts provide learning resources for **all** students as well as a reference document for teaching staff. The approach can be extended to a range of speech-based Audio Visual (AV) materials, enabling free-text searches of such resources.*

We envisage further potential to support learning and teaching activities by students and teaching staff through the ability to annotate and hyperlink transcripts that are synchronised to source AV materials.

Keywords

Transcript generation, AV searching, learning support

1. OVERVIEW OF PROPOSED POSTER



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CONTEXT-BASED TEACHING – A KEY TO GRADUATE EMPLOYABILITY FOR COMPUTER NETWORKING COURSES

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ABSTRACT

*The research provides an evaluation on whether problem-based learning is superior to traditional teaching methods in developing essential employability skills. **Employability, a complex notion**, encompasses an understanding of discipline, efficacy beliefs and metacognitive fluency. Problem-based learning, that is acclaimed to provide a rich learning environment and opportunities for students to develop desirable employability characteristic, befits facilitation of computer networking courses due to its problem-oriented nature.*

This research focuses on using a framework approach to deliver problem-based learning to computer networking modules within the context of undergraduate degree program in Computing. The problems, simulated case studies and those drawn from real-life network problems are used as a context to understand, apply and actively rehearse wide ranging employability skills in a supervised environment, allowing for additional feedback and skills development.

Interim evaluation of the research, which is a work in progress, demonstrates a positive take-on of this new pedagogy by students.

Keywords

PBL Problem Based Learning

The problem-oriented nature of computer networks lends itself to problem-based learning (PBL), which is claimed to integrate many of the requirements stated by graduate recruiters into the learning experiences of students, and therefore aid employability.

The funnel-approach [1] to problem-based learning is used. The research differs from the existing PBL interventions in the discipline, by using a framework approach for step-wise induction to problem-based learning for computer networking modules on the undergraduate degree program.

The problems, simulated and derived from real world network problems, provide the context to understand, apply and actively rehearse and practice wide ranging employability skills in a supervised context. The pedagogic framework uses traditional lecture-led practical work for the first year module, followed by development of problem-solving skills for structured problems for second year module, leading to problem based learning of complex, ill-structured and interdisciplinary problems for the third year module. The framework is currently implemented for the first and the second year modules. Student evaluation of the approach demonstrates positive feedback. Analysis of students' attainment at the end of the year would lend another insight into progress of this new pedagogy and the lessons learnt would feed into the future delivery of modules.

REFERENCES

- [1] Savin-Baden, M., Howell Major C., *Foundations of Problem-based Learning*. Maidenhead, U.K. Open University Press (2004).

USING COMPETITION TO SUSTAIN MOTIVATION – TOPS EVOLVES

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ABSTRACT

Supporting and sustaining the motivation of our most able and experienced first year undergraduates in introductory programming modules is as important as providing a supportive environment for novices who face a greater and more difficult challenge of mastering their first programming language. Designing and integrating additional challenges into the curriculum can be time consuming and onerous for the individual academic tasked with instructing an introductory programming module. This poster reports on the progress of the HEA-ICS funded TOPS initiative which promotes academic collaboration to stage an inter-university competition for first year programming students. Although the organisational and logistical are complex, students have found the activity rewarding both during the competition, and through subsequent reflection.

Keywords

programming, competition, diversity, retention, motivation.

1. THE COMPETITION

The TOPS inter-university programming competition has now been running for three years. Over time the composition has changed a little. The competing institutions have changed and grown in number, sponsorship has come from different sources, and each year a novel programming challenge theme has been identified. The basic structure of the activity has been constant. There are two strands to the competition each offering prizes for the winners. Initially a group of students from each institution create a challenge for pairs of students from other institutions. This is prepared in advance of the competition day, when the university teams, comprising two pairs of students attempt each of the challenges created in the first strand (apart from their own). To accommodate variability in difficulty between challenges marking is normalized. Each university teams comprises five students, four of whom attend the competition event.

2. REFLECTIONS

Variability of the academic year across institutions, different educational approaches and choice of languages present challenges to the competition design. Evidence from the students' perceived enjoyment, and their awareness of activities at other institutions is a benefit. HEA-ICS benefit through an opportunity for contact with students across a range of institutions, seeding awareness for future contact. Detractors might argue that competitive activities are exclusive, perhaps being less attractive to female students than to males. Some colleagues in our community believe that this type of activity is a manifestation of elitism; implying superiority in teaching or academic ability. This poster provides the opportunity for colleagues to consider their views and possible contributions to or participation in future activities of this type.

3. ACKNOWLEDGEMENTS

The authors wish to thank the HEA-ICS for their ongoing support for this initiative.

4. REFERENCES

- [1] Carter J. Efford N, Jamieson S Jenkins T, White S, Taxing our best students, *Italics*. **7,1**, 120-127 (2008).

ELECTRONIC ASSESSMENT TECHNIQUES FOR COMPUTING SUBJECTS

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ABSTRACT

The poster will discuss the work undertaken for the Higher Education Academy Development Fund project: 'Efficacy and appropriate use of electronic assessment techniques for computing subjects'.

The project is investigating whether innovative electronic assessment methods used for computing students at Sheffield Hallam University, such as phase tests which utilise electronic marking and feedback, enhance students' learning and offer suitable feedback. The project also explores the impact of these assessment methods on staff, especially in terms of time and workload, and their perception of the success of the methods. The project aims to develop an evidence base to inform discussions on how to use these assessment and feedback methods most effectively, and to produce good practice guidance for staff.

The poster will summarise the major findings of the research, evaluating the success of the electronic assessment methods and outlining good practice guidelines for any subject group considering utilising phase testing. Members of the project team will be available to discuss the project with attendees and answer any questions that they may have about the practical implications of the research outcomes.

Keywords

Pedagogic Innovation, Evaluating Learning and Teaching, Improving Assessment and Student Feedback, Distance Learning / Virtual Learning, Supporting New Academic Staff*

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EVIDENCE-BASED SOFTWARE ENGINEERING

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ABSTRACT

Context: *An evidence-based approach involves aggregating the data on a software engineering topic to identify good practice and assess the effectiveness of software engineering practices.*

Keywords

Website, Evidence-based software engineering

1. AIM

We are seeking to provide details of evidence-based practices for software engineering, including materials for teachers and students.

2. METHOD

We have produced a website (www.ebse.org.uk) to provide information on evidence-based software engineering targeted at researchers, practitioners, teachers and students. It contains a variety of resources, including a comprehensive glossary, a bibliography, lecture notes and learning materials, guidelines and templates. It also describes successes students have had in employing evidence-based approaches, such as systematic literature reviews, mapping studies and structured abstracts.

3. RESULTS

The website is a work in progress, but is already proving a valuable resource to students all around the world. We are always aiming to improve the website and seek feedback on the resources it provides, and suggestions or contributions of further materials.

VISUALISING STUDENT UNDERSTANDING AND TROUBLESOME KNOWLEDGE IN A FIRST YEAR COMPUTER SCIENCE MODULE

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ABSTRACT

A project funded by the Higher Education Academy partnered academic developers with lecturers in Classics, Computer Science, English, Law, Mathematics, Pharmaceuticals, Psychiatric Nursing and Veterinary Science, using concept mapping and interviews to document student learning quality. It was of immediate benefit to the students who took part because it used a tool, concept mapping that has been shown to enhance student learning quality. The intention was also that research data collected in the project would inform teaching practice in the respective disciplines. In addition, the project contributed to the teaching enhancement agenda and supported and developed participating teaching staff.

In Computer Science, the project used concept mapping and interview techniques to measure cognitive change in students' understanding of Human Computer Interaction (HCI) and the lecturer's conceptions of teaching. The project team have developed the concept mapping method to make learning visible and to measure learning quality through the tracking of cognitive change.

A target population of first year undergraduates studied a module where HCI was an essential component. A case study to evaluate the lecturer's approach and the impact on student learning was carried out. The intention was to respond to the lecturer's concerns that students may grasp theoretical knowledge on this course, but they do not manage to link up theoretical knowledge of concepts with practical applications.

Student understanding of HCI was measured before and after the course by the use of concept mapping. We asked the students to make concept maps of a broad HCI concept. With concept mapping, issues of pedagogy have been surfaced which would have been buried anyway. By surfacing the novice student way of thinking, the lecturer can see the lack of correspondence between student perceptions and teaching approaches.

A need for cycles of development of pedagogy was identified. These should be always informed by the student tentative attempts, because they indicate what needs to be explained and the level of granularity in the lecturer explanations. With a transmissive approach, the students do not get to see where the lecturer leads them towards, i.e. to think like a computer scientist.

Students seemed to take a programmer's rather than a designer's perspective on HCI, and the implication was that they did not really appreciate what design is. Possible teaching approaches could focus on problem based learning, or engaging them in activities that put them in the position of a designer.

Finally, our data suggest that measurement of student prior-knowledge and subsequent teaching design is essential for effective learning materials design.

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